Prepared for:

Chino Mines Company

Hurley, New Mexico

DRAFT

Administrative Order on Consent

Interim Remedial Action
Groundhog Mine Stockpile
Site Investigation Report
Hanover and Whitewater Creeks Investigation Unit

Prepared by:

Golder Associates

Tucson, Arizona

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1. INTRODUCTION

Volume material to be removed

Drivers for closure

This document has been prepared pursuant to the Conditional Approval Letter from the New Mexico Environment Department (NMED) dated January 24, 2000 and reports the results of the site investigation of the Groundhog Mine area (Figures 1 and 2), within the Hanover/Whitewater Creeks Investigation Unit (H/WCIU). This report was prepared by Golder Associates Inc. (Golder) under contract to Chino Mines Company (Chino). The purpose of the site characterization was to define the chemical nature and physical extent of mining-related materials at a level sufficient for Chino to evaluate remedial requirements and options for the site.

Pb/Zn

Size & extent of surrounded dump cover

The Groundhog Mine falls under the jurisdiction of three regulatory programs. First, reclamation activities fall under the jurisdiction of the New Mexico Mining Act (NMMA) administered by the New Mexico Energy Mineral and Natural Resources Departments (1) Mining and Minerals Division. A closeout plan is required under the NMMA rules, and the Groundhog Mine is included in the proposed closure/closeout plan for the Chino Mine. Second, the Groundhog Mine is not included in a discharge plan administered by the (2) Groundwater Quality Bureau of the NMED. Consequently, the NMED and Chino have elected to address possible groundwater issues under the Chino Administrative Order of Consent (AOC) as part of the H/WCIUs. Finally, surface water runoff at the Groundhog (3) Mine falls under the jurisdiction of Chino's Multi-Sector General permit under the National Pollutant Discharge Elimination System administered by Region VI of the U.S. Environmental Protection Agency (EPA).

The site investigation was completed as outlined in the Interim Remedial Action Groundhog Mine Stockpile, Site Investigation Workplan Hanover Whitewater Creeks Investigation Unit (Golder, 2000). The scope of the workplan included:

- Chemical characterization and evaluation of the lateral and vertical extent of stockpiles,
- Chemical characterization and surveying of roads and building foundations constructed of suspect materials,
- Geotechnical sampling along pipelines to address stability issues related to removal of materials adjacent to the pipelines,
- Sampling and inspection of the existing soil cover materials to address reclamation requirements, and

- Seepage monitoring below the headwall constructed across the drainage at the downstream end of the site.

Chemical characterization included field descriptions of materials and laboratory analysis for metals content, acid generating/neutralizing potential, and leaching characteristics. Geotechnical samples were archived at Chino for possible future analysis of physical properties of the stockpiles in the case that removal of materials near pipelines is selected as a remedial option. Samples were collected from the surface and from test pits excavated by hand or backhoe. Forty-two samples were collected for chemical analyses and three samples were collected for possible future geotechnical analysis

After completion of sampling activities, a survey of sample sites, exploratory test pits, and other key features of the study area was performed. The survey was conducted by Engineers, Inc. of Silver City, New Mexico.

The workplan study area is shown in Figure 2. For the purpose of this investigation, four stockpiles in the study area were referred to as G1 through G4 from the south to the north as shown in Figure 2. Stockpiles G1, G2, and G3 are adjacent to the Groundhog No. 1 Shaft, the Groundhog North Shaft, and the San Jose Shaft, respectively. Stockpile G4 is northwest of Stockpile G3, near a shaft identified on a historical working map as the Homestake Shaft. Each of these stockpiles has been reworked, graded, and/or covered to some extent, and the boundaries shown in Figure 1 (the workplan map) were estimated.

This report is organized into seven sections. Section 2 describes general site characteristics. Section 3 summarizes the vegetation/soil cover investigation completed by Tetratech-EMI in June 2000 (Appendix A). Section 4 summarizes the field investigation and chemical analyses performed. Section 5 presents the results of the investigation, geochemical interpretation of the lithologic and chemical data, and volume estimates of mine-related or mine-impacted materials. Section 6 presents the overall conclusions of the investigation. The final section, Section 7, lists documents referred to in the main text.

2. SITE DESCRIPTION

The Groundhog Mine is located in the valley of a north-flowing unnamed tributary to Whitewater Creek, north of Bayard Canyon. The underground mine operated from as early as 1869 (Lasky, 1936) until approximately 1978, producing primarily lead and zinc. Mineral deposits of the area are complex quartz-sulfide veins. The ore minerals are sulfides of copper, lead, and zinc, with minor silver and gold (Howard, 1967). The vein in the Groundhog area runs along the eastern edge of the valley, striking generally northeast. Prior to mining activities, the vein cropped out for approximately one-half mile and extended southwestward for an additional 3,000 feet or more along the east side of Bayard Canyon, where it was covered by Tertiary sedimentary rocks (Lasky, 1936). At the location of the San Jose Shaft, the vein outcrop formed a "prominent wall of jaspery quartz". The vein is now covered by stockpile material and a vegetated soil cover.

The unnamed tributary drains an area of approximately 100 acres. Chino constructed a headwall that tied into bedrock downgradient of most of the existing stockpiles (Figure 2) in 1996. Diversion ditches were also excavated to route upgradient surface water around the site in 1996. In June 2000, Chino installed a drainfield upgradient of the headwall and a subsurface hydraulic barrier across the rest of the drainage. Seepage water collected in the drainfield is currently being pumped from the drainfield into the Chino process water system (DP-526). Much of the surface water runoff in the area is routed around the valley by a series of upgradient diversion ditches constructed in 1996. Surface water runoff originating from the covered stockpiles is separated from seepage water by a synthetic liner and is allowed to discharge to Whitewater Creek.

The mine was last operated by Asarco but was previously owned by a number of companies. Chino obtained the property from Asarco in 1994. Prior to transferring the property, Asarco relocated several stockpiles from Bayard Canyon, combined several stockpiles associated with the Groundhog operations, and covered them with several inches of cover soil from nearby hillsides. Estimated stockpile locations prior to the investigation are shown on Figure 2.

Digital topography was developed from an aerial survey flown in 1999. No significant regrading has occurred in the area since the date of the aerial survey and it is believed that the digital topography accurately reflects current conditions. Figure 2 shows the general site layout with a 5-foot contour interval.

3. VEGETATION/SOIL COVER INVESTIGATION

An investigation of the vegetation and soil covers over the stockpiles was conducted by Lewis Munk of Tetratech-EMI and is attached as Appendix A.

4. SUMMARY OF FIELD INVESTIGATION

Golder conducted a field investigation from June 12 to 22, 2000. The investigation included:

- observing surface indications of the lateral and vertical extent of mine-related materials,
- monitoring seepage below the headwall,
- excavating test pits and geologic logging, and
- sampling for chemical and geotechnical analyses.

Each of these components of the field investigation is described below. Results of the investigation are discussed in Sections 5.

4.1 Surface Observations

Visual inspections of the surface conditions were conducted throughout the study area to define the lateral and vertical extent of the stockpiles and soil covers where they were exposed by rills. Observations were noted on field maps or in the field notebook (Appendix B). Specifically, the perimeters of each stockpile, rills, trenches dug around the pipeline corridor (Figure 2), and foundations were inspected for evidence of mine-related materials and the degree of mineralization. The condition of the soil cover was noted during Golder's investigation, and was inspected in detail by Tetratech-EMI (Appendix A).

4.2 Seepage Monitoring During Field Investigation

The culvert below the headwall was inspected daily by either Chino or Golder personnel during the field investigation. Seepage was not noted, although occasional precipitation events occurred throughout the investigation. In addition, no surface seeps were noted at any location within the study area during the investigation.

4.3 Test Pit Excavation

Thirty-one test pits were excavated during the June 2000 field investigation (Table 1), including

- 10 stockpile test pits listed in the workplan (designated with the letter "G" in the identification),

- 14 exploratory test pits (designated with the letters "EP"),
- 3 foundation test pits (designated with the letter "F"), and
- 4 test pits in roads (designated with the letter "R").

The test pits were excavated by James Hamilton Construction Company under contract to Chino. Eighteen of the test pits were excavated using a 235 Cat Excavator, and 13 were excavated using a 2689 Cat Backhoe. The locations of the test pits are shown on Figure 3.

Prior to test pit excavation, a utility locate was conducted and One Call notified Chino that no underground utilities were located in the study area. However, active overhead power lines; buried tailing, process water, concentrate, and liquid nitrogen pipelines (Chino pipelines); and a fiber optics cable owned by Chino run through the center of the valley of the unnamed tributary and Bayard Canyon. The approximate location of the Chino pipelines is shown on Figure 2 and marked on the ground by stakes. The pipelines are buried together in a corridor approximately 20 feet wide. No test pits were excavated within 20 feet of the assumed edge of either side of the corridor, prohibiting investigation of an approximately 80-foot wide corridor at the low point in the drainage. However, previously excavated trenches and surface features aided in defining this area. The fiber optics cable is supported by a series of poles along the new eastern road (Figure 2). In addition, a telemetry station is located at the toe of Stockpile G1. It was rationalized that any utilities potentially buried in the former residential area on the west side of the valley were inactive and did not pose a safety or environmental risk during these excavation activities.

The stockpile test pits were logged according to the Unified Soil Classification System, with particular emphasis on noting stratification, moisture conditions, secondary mineralization, and lithology of the mine rock. This information was considered critical in drawing correlations with materials and conditions observed in exploratory test pits that did not have samples submitted for laboratory analyses. Detailed logs for the stockpile test pits are included with this report as Appendix C. Soil descriptions and sketches of exploratory test pits, and test pits in foundations and roads, are included in the field notes (Appendix B). Each test pit was excavated to refusal or to the maximum reach of the excavator or backhoe.

The root zone thickness was noted, as well as the stratigraphy and staining, if any, of soil underlying the mine-related materials, and any other identifying characteristics. Vegetation characteristics on stockpiles should not be evaluated based on the vegetation encountered during test pit excavation alone because the pit locations were often selected in areas of least vegetation in order to minimize the impact to the vegetation cover.

Following excavation, the dimensions of each pit were measured and a survey stake placed at a measured distance from the pit. The pit was then back filled and compacted as described in Standard Operating Procedure (SOP) 21 (Chino/Steffen, Robertson, and Kirsten [SRK], 1997). After compaction of the backfill, the stake was measured back to a corner of the pits, and the corner noted in the field notebook. Topsoil was replaced over each test pit location by Chino following the field investigation.

4.3.1 Stockpile Test Pit Excavation

The locations of the stockpile test pits for the initially identified stockpiles (Figure 2) described in the workplan (Golder, 2000) were adjusted in the field based on observations of the stockpiles, utility locations, and access. However, each of the planned stockpile test pits was excavated through the entire stockpile profile and located in an area suitable for characterizing the target materials, as discussed in the workplan.

During excavation of each stockpile test pit, subsamples were collected from each 2-foot interval. Soil and weathered or fractured bedrock underlying stockpiles were sampled discretely or at 2-foot intervals, depending on the thickness of the materials. Subsamples of similar materials were composited as described in Section 4.4. Samples collected from stockpile test pits are listed in Table 1.

4.3.2 Geotechnical and Exploratory Test Pit Excavation

Fourteen exploratory pits were excavated at the stockpile margins and between stockpiles to define their lateral extent and ensure that all general types of mine-related materials were defined. Two of these exploratory pits were used to obtain geotechnical samples discussed in the workplan. The geotechnical test pits were originally located to target areas near the pipelines in order to sample materials to be left in-place, regardless of removal options, to maintain stability of the materials surrounding the pipeline corridor. However, due to the heterogeneity of the materials encountered during the field investigation, the geotechnical test pits were combined with exploratory pits or "roadbed" test pits (Section 4.3.3) to maximize the spatial coverage of the stockpiles in addition to characterizing the physical properties of materials near the pipelines. Geotechnical samples obtained from exploratory test pits are listed in Table 1.

Exploratory test pits were not sampled for chemical analysis unless a material type was encountered that was markedly different from the materials encountered in the stockpile test pits, or was considered to be a bounding example of a particular material. For example, EP-3 was sampled at a depth of 2 feet because the material encountered at that depth was visually determined to be the "worst case" example of a pyritic sulfur-bearing clayey layer of weathered stockpile material.

4.3.3 Roadbed Test Pit Excavation

Four test pits were excavated into the roadbeds (Figure 3). Roadbeds were sampled according to the workplan to investigate material types and thicknesses underlying the roads in the study area. Samples were collected from each interval of the four roadbed test pits that was judged by the field geologist to be significantly different in its appearance from materials seen in stockpiles and present in sufficient volumes to influence remedial alternatives. Samples were collected and composited in the same manner as the stockpile test pits. Soil and weathered or fractured bedrock underlying stockpiles were sampled discretely or at 2-foot intervals, depending on the thickness of the materials.

4.3.4 Foundation Test Pit Excavation

Foundation remnants were initially identified as wall footings or concrete pads in the areas classified as "residential" (Figures 4 and 5) and "suspect materials" area (Figure 2). During the field investigation, foundations in these areas were inspected and determined to be two distinct material types. Foundations in the residential area are typically cut into weathered bedrock with fill found in the housing footings or adjacent roadways ("driveways"). Tuff bedrock is near-surface in the residential area. Foundations in the suspect materials area are remnants of buildings related to mining operations and are typically located on fill composed of stockpile material. Figure 4 is an aerial photograph taken in 1979, prior to dismantling and removal of buildings in the study area.

One test pit each was excavated into a residential housing foundation, a driveway adjacent to a residential housing foundation, and a foundation in the suspect materials area (Figure 3). The foundation materials were described and sampled as one composite across the entire interval of the foundation.

4.4 Sampling and Analysis

Forty-one samples were collected for chemical analysis, including one sample which was archived for possible future analysis. Three samples were collected for possible future geotechnical analysis. Sample locations, identification numbers, depth intervals composited, and the sampling date are listed in Table 2. Sampling and analysis procedures are summarized below.

4.4.1 Sampling Procedures

Test pits excavated to less than 4 feet were sampled from the pit wall according to SOP 21 (Chino/SRK, 1997), "Sample Collection From Soil Borings, Excavations, and Hand Dug Pits". All sampling activities were documented according to SOP 2, "Field Logbook". The SOP (Chino/SRK, 1997) was modified for deeper pits to allow collection of discrete samples from the excavator bucket and compositing from these materials as described below.

Two types of samples were collected from the test pits:

- Composite samples. Composite samples were collected from distinct layers exhibiting a thickness of 2 feet or greater. One subsample was collected for each 2-foot interval. These subsamples were composited over each interval of the same material type.
- Grab Samples. A grab sample from the soil underlying the stockpiles or roads was collected at each test pit. In addition, five grab samples were collected from exploratory pits.

The project-specific sampling procedure developed for pits deeper than 4 feet was as follows:

- The operator collected a volume of soil with the bucket of the excavator backhoe from each 2-foot interval or distinct layer as appropriate, and emptied the bucket on the ground in the sampling area. The depth interval of the excavated material was confirmed by measuring the pit depth. The depth of the pit was generally within 2 inches of the desired depth.
- The field geologist inspected and logged the soil as described above.
- Approximately 1 gallon of the material was collected in a 3-gallon plastic bucket using a plastic bag as a liner, labeled with the depth interval, and held until the excavation was complete.
- The final sample was a single grab sample of the soil underlying the mine-related materials. If no soil was encountered, weathered or fractured bedrock was sampled. After description, the sample of underlying materials was placed directly from the pile

into plastic ziplock bags, and labeled according to SOP 4 (Chino/SRK, 1997), "Sample Custody and Documentation Procedures". Sample numbers are consistent with the current AOC protocol for samples collected in tributaries of Whitewater Creek.

- Grab samples from each 2-foot interval were composited by placing the materials from the 3-gallon buckets together on a clean sheet of plastic and mixing them together thoroughly. The number of composite samples was decided by the field geologist based on layering and types of materials present.
- Two splits of approximately 1 kilogram (kg) each were collected from the composited materials and double-bagged in plastic ziplock bags. Both the inside and outside bag were labeled according to SOP 4 (Chino/SRK, 1997). One of these splits was sent to SVL Analytical in Kellogg, Idaho. The other split was archived at Chino.

Geotechnical sampling does not have a site-specific SOP. Disturbed bulk samples of materials were collected from elevations below the pipelines in two exploratory test pits and one roadbed test pit. The three samples represent the range of materials near the pipeline which may control their strength should the configuration of the stockpiles be changed during any potential removal option chosen as part of the selected remedy. The samples were collected from the test pit and logged in the same manner as grab samples from stockpile test pits. Approximately 4 gallons of the material were transferred to a 5-gallon plastic bucket, sealed with a lid, and labeled according to SOP 4, "Sample Custody and Documentation Procedures" (Chino/SRK, 1997). The sample number reflects the test pit identification and the sample depth (Table 1). Geotechnical samples are archived at Chino for possible future analysis of physical characteristics, if needed.

Foundation materials were relatively thin and homogenous compared to stockpile materials. Composite samples of two of the foundations were collected from an interval exposed by the backhoe as described in SOP 21 (Chino/SRK, 1997). The third foundation was sampled by compositing subsamples from the bucket of the backhoe, as in the stockpile and roadbed samples, because the test pit was greater than 4 feet deep. Samples were collected from fresh unweathered cross-sections within the excavation, and not from materials which had been exposed at the surface. The depth interval for the composite sample began at least 12 inches below the surface and extended to the base of the foundation. Foundation test pits were located to expose the thickest section of the foundation material possible. Samples were collected with a clean gloved hand and placed in ziplock bags as described above for stockpile test pit sampling.

All samples were placed in appropriate sample containers, labeled, and stored in an ice chest with blue ice. A chain-of-custody form was completed for each sample to be submitted for chemical analysis. Analytical requirements for each sample were noted on the chain-of-custody form. Samples were shipped by Chino to SVL Analytical in accordance with SOP 5, "Packaging and Shipping of Environmental Containers" (Chino/SRK, 1997).

Archived samples in plastic bags are stored in ice chests or 5-gallon buckets in a dry location at Chino facilities. Each bag is labeled with the same information as the analytical sample.

4.4.2 Laboratory Analysis

SVL Analytical performed paste pH, Acid-Base Accounting (ABA), and total metals testing on each sample. Short-term leach testing (EPA Method 1312, Synthetic Precipitation Leaching Procedure [SPLP]) was performed on a subset of these samples. SPLP is a screening test designed to indicate the potential for a material to leach metals under the effects of percolating meteoric water. Samples submitted for SPLP analysis were selected to represent the materials in each of the stockpiles, roadbeds, and foundations based on visual observations, ABA, and total metals results. If several samples of similar material were collected within a stockpile, worst-case (most mineralized) or bounding examples were selected for SPLP analysis.

Samples were air dried and crushed to 3/8-inch by SVL Analytical according to SPLP Method 1312. A subsample was then pulverized to -160 mesh (approximately 0.09 millimeter) for saturated paste pH (American Society of Agronomists Method 9), ABA (Modified Sobek) and total metal analysis (EPA Method 3050). The Modified Sobek Method includes determination of pyritic sulfur and calculation of AP based on pyritic sulfur content. Total metals analysis includes a rigorous digestion and results are not necessarily indicative of leachable constituents. The samples were not sieved prior to crushing. The analytical suite for chemical analyses of total metals and the SPLP leachate is listed in Table 2.

4.5 Equipment Decontamination

Disposable equipment was used to the extent possible to reduce opportunities for cross contamination and decrease decontamination requirements. Buckets used for holding subsamples prior to compositing were lined with a plastic garbage bag to eliminate bucket decontamination between samples. Samples were collected by hand using clean gloves.

Compositing was accomplished by placing approximately equal proportions of each subsample onto a piece of plastic and mixing the subsamples by rolling the sample in the plastic. The composite sample was then placed in plastic bags using clean, gloved hands.

For reusable field equipment, decontamination followed SOP 6 (Chino/SRK, 1997), "Decontamination of Equipment Used to Sample Soil and Water", with the modification that no nitric acid rinse was used on any equipment. In addition, the bucket of the excavator was brushed out between samples with a stiff broom to remove any loose material. Free water was not encountered in any of the test pits, and soil was easily removed using the broom.

5. RESULTS OF FIELD INVESTIGATION

This section summarizes the chemical nature and estimated vertical and lateral extent of mine-related materials in the study area. The chemical nature of stockpile materials is based on field observations of material types and laboratory chemical analyses. The estimated vertical and lateral extents are based on field observations of surface and subsurface features, historical photographs, 5-foot interval topographic data, and professional judgement. Section 5.1 presents the field observations (i.e., geological descriptions), Section 5.2 presents the laboratory analytical results and geochemical interpretations, and Section 5.3 presents the lateral/vertical extents and resulting estimated volumes.

5.1 Geological Descriptions

Following excavation of the stockpile test pits, a series of 14 exploratory test pits was used to investigate the lateral variations in the stockpiles and the suspect materials area, and to define the edges of the stockpiles where they were indistinct. As discussed in Section 4, the buried Chino pipelines prevented investigation of the north-south corridor of the valley, and overhead utilities, a fiber optics cable, and the telemetry station limited subsurface investigation of the area along the western toes of Stockpile G1, and to a lesser degree, Stockpile G2. Uncertainty exists in defining the lateral extent of stockpiles near the Chino pipelines and other infrastructure.

Exploratory test pits were not logged in as much detail as the stockpile test pits to minimize the logging time and maximize the number of test pits. However, no distinctive materials were observed during excavation of exploratory test pits that were not encountered in the stockpile test pits. Generally, materials sampled during exploratory test pit excavation were used to bound or confirm results from the samples collected from the stockpile test pits.

Roadbed test pits R1 and R2 revealed a previously undefined stockpile, referred to as G5 (Figure 6) in the following sections. Stockpile G3 was redesignated into three separate areas based on the nature of the materials encountered: G3 West, G3 East, and "suspect materials" (Figure 7). A summary of the geologic descriptions for each area is presented below. Figures 8 and 9 are cross-sections showing the limited degree of stratigraphy which may influence selection of remedial designs. Detailed logs for the stockpile test pits are in Appendix C and geologic observations and descriptions for all other logs are in Appendix B.

The investigation was designed to characterize the occurrence of shallow groundwater as well as lithology. Several stockpile test pits were located in areas which were identified as topographic lows prior to mining. However, water was not encountered in any of the test pits. Generally, the stockpiles were damp in the subsurfac except in gravel lenses. In addition, seepage paths were not identifiable from visual observations or chemical analyses.

5.1.1 Stockpile G1

Stockpile G1, the southernmost stockpile, is associated with the Groundhog No. 1 Shaft. Stockpile material from Bayard Canyon associated with the Lucky Bill Mine was relocated by Asarco to the southern and northern flanks of Stockpile G1 in 1994 (personal communication with T. Neal, Recwest Incorporated). Three stockpile test pits and four exploratory test pits were excavated to investigate the stockpile. While some segregation of materials was observed, the presence of relocated materials at the flanks of the stockpile was not distinguishable.

The soil cover ranged from 0 to 2 feet thick. Soil thinned on the steep slope areas and was thickest on the top near test pit G1-2.

In the upper interval, the stockpile is composed primarily of limestone cobbles in a sandy matrix with secondary gypsum mineralization. In the lower interval, the stockpile is highly weathered with mineralized porphyry clasts, some granite and tuff clasts, in a clayey yellow matrix with a slight sulfur smell. Mineralization was primarily pyrite with minor bornite and other accessory minerals. Secondary iron oxide mineralization in the matrix was common. Limestone was not observed in the lower interval.

Little or no soil or weathered bedrock was encountered beneath the stockpile material. However, a conglomerate was encountered at the northern end of the stockpile in test pits G1-3, EP-3, and EP-4. The bedrock was not encountered below the conglomerate, which was up to 19 feet thick, due to insufficient reach of the excavator.

The eastern and southern perimeter of the stockpile was identifiable at the contact with the tuff bedrock outcrops on the hillside and in the drainage ditch. The Stockpile is located on the saddle between the unnamed tributary and Bayard Canyon, and approximately 30% of the stockpile is within the Bayard Canyon watershed. The northern boundary was identified as at or near G1-3, where no stockpile material was found, but some iron oxide precipitates had formed. The western toe of the stockpile was not defined due to the presence of the Chino pipeline, overhead power lines, and the telemetry station, but two trenches previously excavated at the pipelines (Figure 4) did not reveal the presence of stockpile material and it was assumed that the stockpile pinched out to the east of the pipeline.

5.1.2 Stockpile G2

Stockpile G2 does not appear to be associated with an adjacent shaft, and may be relocated material from Bayard Canyon. Two test pits were excavated into the stockpile (G2-1 and G2-2). The material within the stockpile was not stratified and appeared to be mixed or disturbed. For example, occasional lenses of clayey soil with roots would be mixed with mineralized clasts which were not weathered. In addition, the underlying soil and bedrock were not significantly weathered and did not contain visible secondary precipitates such as gypsum or jarosite. Figures 6 and 8 show the lateral extent and cross-section of Stockpile G2.

The soil cover ranged from 0 to 1.5 feet thick. The cover was thickest on the flat southeastern portion, and thinned on the northern slope.

The stockpile material was characterized by rounded tuff boulders and smaller clasts of granitic porphyry with feldspar phenocrysts and pyrite mineralization, small clasts and veins of chrysocolla, galena, and other associated minerals. Lenses of clay within the stockpile material had secondary iron oxide and copper hydroxide precipitates, but weathering rinds on clasts were generally thin. Underlying soil was mixed with relatively unweathered fractured bedrock approximately 2 feet thick in both test pits. Bedrock was gray siltstone that contained iron-rich quartz veins.

Exploratory Pit EP-12 north of G2 did not indicate the presence of mining-related materials. The southern and eastern extent were estimated based on the character of the surface (trees and artifacts). The western edge of the stockpile is buried beneath the new road and is assumed to extend to the edge of the pipeline corridor.

5.1.3 Stockpile G3 East

Stockpile G3 is associated with the San Jose Shaft and appears on historical maps and in literature published as early as the 1930s. One stockpile test pit (G3-1) and three exploratory test pits (EP-5 through 7) were excavated into the stockpile. Figures 7 and 9 show the lateral extent and cross-section of Stockpile G3.

The soil cover ranged from 0 to 1 foot thick, but did not sustain vegetation over the western half of the hillside, which had a hard crust.

The stockpile material was characterized by highly weathered clayey gravels of granitic, red quartz-veined rock, and mineralized porphyry with pyrite phenocrysts. Pyrite was common and the material had a slight sulfur smell. The clayey matrix was yellow with precipitates ranging in color from orange to purple and clasts were coated with clay. In the eastern area of the stockpile, where the soil cover supported vegetation, there was a larger fraction of granite cobbles that were highly weathered to the point where the cobbles became moldable with the hand.

Underlying soil was thin and mixed with gravel from the underlying colluvium or the stockpile material. Beneath the soil was an interval of 6 to 7 feet of non-mineralized gravels which may be disturbed weathered bedrock. The bedrock was weathered granitic rock with iron-rich quartz veins.

The stockpile was defined laterally by visible contacts to the north, east, and west. The toe of the deposit was evident in EP-5 and, especially, EP-7, where the yellow clays pinched out and limestone cobbles were present grading in from the south.

5.1.4 Stockpile G3 West

Stockpile G3 is probably associated with the Groundhog North Shaft and appears on historical maps as a steep hillside deposit shown on Figure 2 as hatching. Three stockpile test pits (G1-1 through 3) and two exploratory test pits (EP-10 and 11) were excavated into the stockpile. Figures 7 and 9 show the lateral extent and cross-section of Stockpile G3.

The soil cover ranged from 0.5 to 1 foot thick. Although the soil cover thinned on the slopes of the stockpile, there were no areas devoid of soil cover or vegetation.

The stockpile material was characterized by the presence of mineralized limestone and dolomite clasts which decreased in frequency with depth. Mineralization in the limestone is primarily pyrite, with some galena, copper hyroxides, and associated minerals. Limestone clasts were mixed with weathered granitic porphyry with feldspar phenocrysts and pyrite mineralization, which increased in frequency with depth. The matrix was generally clayey, variably stained with iron oxides, and reactive with hydrochloric acid. In G3-2, a weathered granite fill was encountered from 10 to 15 feet below ground surface (bgs). The granitic clasts were highly weathered to the point where the cobbles became moldable with the hand.

Underlying soil was thin and mixed with gravel from the underweathered bedrock or the stockpile material. Beneath the stockpile material, the soil/weathered bedrock layer was approximately 5 feet thick consisting of weathered pink/green altered granite. The bedrock was pink/green altered granite.

The stockpile was defined laterally by visible contacts to the north and northeast. The toe of the deposit was not seen in the drainfield excavation and was assumed, based on the slope, to end several feet to the east of the drainfield. Materials adjacent to the drainfield were similar to the road bed materials seen in test pit R3 (section 5.1.8). The drainfield was not excavated at the southwestern portion of the toe (near EP-10) and the southern part of the drainfield liner may overlay stockpile material form G3 west. The eastern boundary was defined somewhat arbitrarily at the eastern edge of the new road, where materials probably grade into the suspect materials area, based on historical photographs showing traffic corridors in that area. The southern toe was defined by EP-10, which had carbonate cobbles at depth not found in the suspect materials to the east.

5.1.5 Stockpile G4

Stockpile G4 is associated with the Homestake Shaft and is a thin deposit with a relatively small surface area. One stockpile test pit (G4-1) and one exploratory test pit (EP-8) were excavated into the stockpile. Figure 7 shows the lateral extent of Stockpile G4.

The soil cover ranged from 1 to 1.5 feet thick. There were no areas devoid of soil cover or vegetation.

The stockpile material was characterized by weathered granitics and tuff, with minor quartz porphyry with finely disseminated pyrite mineralization. The matrix was a gravelly sand with orange staining. Underlying soil was thin (>1 foot) and contained roots. Bedrock was fractured, weathered tuff.

The stockpile was defined laterally by historical photographs, the lack of waste rock in the stream bed to the north and rills to the east, and the beginning of a stand of trees to the south. The western edge was defined by excavating EP-8, which confirmed that the stockpile pinches out at the tree line.

5.1.6 Stockpile G5

Stockpile G5 is probably associated with the Groundhog North Shaft and appears in the 1979 aerial photograph (Figure 4). Two roadbed test pits (R1 and R2) were excavated into the stockpile. Figures 6 and 8 show the lateral extent and cross-section of Stockpile G5.

The soil cover was approximately 1 foot thick in the northern portion of the stockpile. The thickness of the soil cover in the southern portion was not defined.

The stockpile material is similar to the upper interval of mineralized limestone in G3 West at the thick northern edge. The southern edge thins to an orange-stained gravel of granitics and gray porphyry with pyrite mineralization. The southern half of the stockpile appears to be a traffic area in Figure 4.

Underlying soil grades from thick (~6 feet) channel deposits at the northern end, at the center of the ancestral drainage, to 2.5 feet of brown soil underlain by 2 feet of weathered bedrock at the southern end. Bedrock is weathered, iron-stained granodiorite.

The stockpile was defined primarily by historical photographs, and confirmed by test pits and bedrock outcrops to the west.

5.1.7 Suspect Materials

Suspect materials are located in an area of high traffic and historic mining operations (Figure 4). The area was characterized with exploratory test pits EP-9 and EP-14. Figures 7 and 9 show the lateral extent and cross-section of suspect materials.

The soil cover was 0 to 1 foot thick, thinning on the slopes and in rills.

The upper interval was similar to that seen on the hillside of G3 East, but was overlain by a thin deposit of limestone cobbles. The lower interval is a disturbed working surface of mixed soil, stockpile materials, and scattered debris. Debris includes concrete, lumber, fabrics, and other artifacts of industrial activity. The lower interval was 3 feet thick in EP-9 and was at least 3 feet thick in EP-14. EP-10, just south of the area, also had a lower interval mixed with debris which was slightly less than 3 feet thick. Bedrock in the area is weathered tuff and granite.

The lateral boundaries of the area were determined to the northwest and north by their intersection with other stockpiles. The eastern edge was defined by historical photographs and surface expressions such as bedrock outcrops and vegetation changes. The southwestern edge is assumed to end at the edge of the Chino pipeline corridor. The southern end was constrained by test pits EP-12 and EP-13, which showed no mining material, and by inspection of rills in the cover.

5.1.8 Roads

Four roads were investigated as shown on Figure 3. Test pits R1 and R2 defined a new stockpile (G-5). Test pit R4 was excavated into the road north of G3 West, but encountered only fractured granite to 6 feet with granitic bedrock.

The only road identified as separate from stockpiles and potentially acidic is the thin horizon with stored acidity beneath the paved road near the drainfield. A layer was identified in R3 from 3 inches (immediately below the asphalt surface) to 1 foot bgs which had some unmineralized granitic cobbles and fines variably stained light yellow. In the drainfield trench east of the road, the near surface stratigraphy varied, but averaged approximately 0.5 to 1 feet of limestone gravel road fill, underlain by another layer of asphalt that may be an old road in some areas and then 1 to 2 feet of the yellow-stained fill. The yellowish layer was underlain by unstained sands and gravels. The lateral extent of this layer, which is assumed to be road fill, extends from the western edge of the paved road, where bedrock crops out, to the drainfield on the east, the headwall on the north, and the southern end of the drainfield to the south.

5.1.9 Foundations

Three foundation were investigated with test pits. All foundations were inspected at the surface. Materials underlying foundations in the suspect materials area were confirmed to be continuous with surrounding materials by test pits F1 and EP-9 (excavated adjacent to a cement slab).

The residential area was inspected in detail. The foundations appear to be filled with conglomerate (pea gravel) seen under the northern edge of G1, as confirmed by test pit F2. Driveways in the residential area were inspected and found to be nonmineralized quartz, tuff, and limestone. The only mineralized material was found in the easternmost driveway which runs parallel to the slope. The material was measured laterally and sampled (F3). The mineralized material was characterized by pink/green altered granite and gray prophyry with pyrite phenocrysts in a sandy matrix stained slightly orange.

5.2 Laboratory Chemical Analysis and Geochemical Interpretation

This section presents the results of laboratory chemical analysis, including ABA, paste pH, SPLP, and total metals. Geochemical interpretations of the results are also presented, including classification of each material based on its Acid Rock Drainage (ARD) potential and paste pH, and correlation analysis of SPLP and total metals results.

5.2.1 Acid-Base Accounting

The ABA results are presented in Table 3. Figures 10 through 15 provide graphical representations of the pertinent results.

In accordance with Price (1997), the following screening criteria are used to classify the samples in terms of their acid potential:

ARD Potential	Screening Criterion	Comments
Likely	Neutralizing Potential/Acid Potential (NP/AP) < 1	Likely ARD generating unless sulfide minerals are non-reactive
Possibly	1 < NP/AP < 2	Possibly ARD generating if NP is insufficiently reactive or is depleted at a rate faster than sulfides
Low	2 < NP/AP < 4	Not potentially ARD generating unless sulfides are preferentially exposed or extremely reactive in combination with insufficiently reactive NP
None	NP/AP > 4	Not acid generating

A fifth category follows an empirical rule of thumb. Materials with a pyrite sulfur content less than 0.3% and a paste pH greater than 5.5 generally are considered non-acid generating regardless of their NP/AP ratio. However, if the rock matrix consists entirely of base-poor minerals (e.g., quartz, muscovite), further evaluation is required (Price, 1997).

It should be noted that these criteria can only be used to identify the potential of a material to generate acid; the likelihood of acid generation and rate at which it occurs cannot be determined from ABA results alone. Long-term testing (e.g., humidity cell) and/or use of field testing/observations is generally required to address the latter issues.

Figure 10 shows the pyrite sulfur versus the total sulfur content. Correlation between sulfide and total sulfur is excellent, and pyrite sulfur on average accounts for approximately 50% of the total sulfur. On average, sulfate sulfur and residual sulfur represent approximately 45 and 5%, respectively. On Figure 11 (sulfate sulfur versus total sulfur), a similar relationship is observed, although at higher total sulfur values the trend starts to deviate. The good correlation between total and sulfate sulfur suggests that the sulfate is derived from the oxidation of sulfides, and is not caused by the presence of primary sulfates (e.g., gypsum, barite).

Figure 12 shows NP values versus AP values. Also included are the linear expressions of the ARD criteria advocated by Price (1997). Based on this classification alone, the majority of samples are designated as having a "likely" or "possible" potential for acid generation (46 and 22%, respectively), with 10% and 22% of the samples being classified as "low" or "non" acid generating, respectively.

Paste pH versus NP values (Figure 13) shows the classical relationship reflecting a general increase in paste pH as the NP increases. A similar pattern is found for paste pH versus NP/AP (Figure 14). The patterns are indicative of a mature stage of acid generation, as demonstrated by a wide range of paste pH values. Figure 13 also can be used to identify the portion of the NP that is unavailable for buffering (i.e., when NP is present in the form of non-reactive minerals). From Figure 13, it appears that this value is approximately 3 kg $CaCO_3$/ton. Figure 14 shows a similar trend. From this graph, it becomes evident that certain samples have maintained an alkaline pH despite a low NP/AP ratio. However, such samples are likely to generate acid sometime in the future.

Figure 15 can be used to make an assessment of the empirical rule of thumb that relates paste pH to pyrite sulfur content. Samples in the upper left quadrant (pyrite sulfur < 0.3 wt%; paste pH > 5.5) are considered unlikely to generate acid. This group consists of 10 samples found in test pits F3, G1-2, G1-3, G2-1, G2-2, R3, and R4. Some of these samples would be classified as potentially acid generating based on their NP/AP ratios, but the low pyrite sulfur content effectively precludes generation of any acid. Several of these samples consist of underlying soil and conglomerate that may or may not be fill.

The lower left quadrant contains samples that contain very little pyrite but have an acidic paste pH. Once again, the majority of these samples is underlying soil or conglomerate (test pits EP-3, EP-6, G1-3, G3-1, G3-2, G4-1, R1, R2, R3). Given their low pyrite sulfur content and native, non-mineralized appearance, it is considered unlikely that these samples themselves generated the acidity through sulfide oxidation. Instead, these samples likely represent material in which soluble oxidation products from overlying waste rock have accumulated, resulting in the presence of stored acidity.

The presence of soluble oxidation products, often occurring as efflorescent salts on the surfaces of mine wastes, is important from a water-quality perspective. These phases store metals and sulfate during dry periods, and dissolve readily during flushing events (e.g., precipitation, snow melt). Sulfates that contain iron or aluminum may have an added impact on water quality. They store acidity and oxidation potential in the form of hydrogen, ferric iron, and aluminum ions. Upon dissolution, the release of hydrogen generates acidity. The dissolution of rhomboclase as shown in Reaction 1 illustrates this process.

$$HFe(SO_4)_2.3H_2O + H_2O = H^+ + 2SO_4^{2-} + Fe^{3+} + 4H_2O \qquad \textbf{(1)}$$

However, more importantly, formation of hydrous iron or aluminum oxides from dissolved iron and aluminum results in the generation of acidity as well. As a consequence, significant amounts of acidity can be generated when iron/aluminum-bearing sulfates dissolve and the released iron/aluminum subsequently precipitates. The dissolution of melanterite in Reaction 2 serves as an example of this process.

$$FeSO_4.7H_2O + 0.25O_2 = Fe(OH)_3 + 2H^+ + SO_4^{2-} + 4.5H_2O \qquad \textbf{(2)}$$

A mineral particularly susceptible to this scenario is jarosite, which was observed as a precipitate in materials in the study area. Jarosite is only stable under very acidic conditions ($pH < 3$), so its presence is generally indicative of highly acidic (micro-) environments. Upon contact with solutions that are more alkaline (e.g., natural rainfall), jarosite dissolves, thereby releasing its hydrogen, when present. In addition, the precipitation of the liberated ferric iron as a hydroxide results in further generation of acidity (Reaction 3):

$$(H,K)Fe_3(SO_4)_2(OH)_6 + 3H_2O = (K^+,H^+) + 3Fe(OH)_3 + 2SO_4^{2-} + 3H^+ \qquad \textbf{(3)}$$

The samples that contain stored acidity, therefore, constitute a potential reservoir of metals and acid that may be released intermittently. Although such samples do not impact water quality through sulfide oxidation, their periodic adverse effects on water quality, while not long-term, can be substantial in the short-term.

The lower right quadrant of Figure 15 represents samples that contain considerable pyrite sulfur and have a low paste pH. These samples have an obvious potential to generate acid. The samples in the upper right quadrant may or may not generate acid depending on their NP/AP ratios.

Based on these relationships, each sample was assigned one of the following classifications:

- Likely to generate acid – 13 samples
- Possibly generates acid – 6 samples
- Low potential to generate acid – 3 samples

- Not acid generating – 10 samples
- Stored acidity – 9 samples

Table 3 includes the assigned classification of each sample. Materials likely to generate acidity occur in each stockpile, except for G2 and in the suspect materials area. Within G1, these samples were located in the lower interval of the stockpile (Figure 8). Within G3 East, which is generally thin, they are located on the west side of the hillside, in the area where vegetation does not grow. Within G3 West, they occur in the lower interval and in the southern half of the stockpile. G4 had only one stockpile sample, which is classified as "likely" to generate acid. R2, at the southern end of Stockpile G5, also fell into this category, although the thicker northern end of the stockpile is classified as "not" acid generating.

Stored acidity is generally found in soil underlying or adjacent to acidic materials, but is also found in one sample each of road fill beneath the paved road near the drainfield and in weathered granite materials found on the grassy eastern portion of G3 East.

Samples classified as "not" acid generating are restricted to the upper interval of G1, in the area of limestone cobbles; the conglomerate found beneath the northern end of G1 and in housing foundations; soil underlying G2 and the paved road near the drainfield; and the fractured granite roadbed north of G3.

All other samples vary from a "low potential" to generate acid to "possibly" acid generating. These materials occur in every stockpile, generally have fairly high AP and NP, and generally are composed of mineralized limestones and/or porphyry waste rock.

5.2.2 Total Metals Analysis and SPLP Results

Total metals analysis and SPLP results are listed in Tables 4 and 5, respectively. Total metals analysis was conducted to determine the nature of the stockpile materials. A subset of the samples was subjected to SPLP testing to determine whether metals identified by total metals analysis had the potential to leach from the stockpiles.

Generally Cd, Cu, Mn, Pb, Zn, Total Dissolved Solids (TDS), and sulfate (SO_4) were identified as having the potential to leach above various potentially applicable groundwater and surface water guidance standards (Table 5). While these results do give some indication of the leachability of the materials, it should be noted that the subset of samples was biased toward materials which have a higher potential to generate acid. Of the fourteen samples submitted for SPLP, only one each was classified as "not acid generating" of having a "low potential" to generate acid. In addition, a sample of each stockpile and road, and two of the three foundations were subjected to SPLP.

Furthermore, it is important to realize that the standard conditions of the SPLP test rarely mimic the natural environment, in particular with regard to the grain size distribution of the solid and the liquid to solid ratio in the test cell. In addition, the SPLP test is unable to account for long-term processes such as sulfide oxidation and subsequent release of acidity and metals. As a consequence, SPLP results may not be representative of a material's short-term and long-term leachability in the field. However, the test generally does provide a qualitative indication of absolute and relative short-term leachability that can be used to identify the chemical species of most concern. A direct comparison between SPLP results and water quality standards is of limited value and should be considered only a qualitative indication.

Correlation analysis was conducted to identify possible relationships between metal content of the mine materials and their leachability. The analysis was performed using the analytical results (chemical composition and SPLP leachate) for the fourteen samples submitted for the SPLP test.

Very little correlation was found between the total metal content of the samples and the corresponding concentrations in SPLP leachates as shown in scatter plots for Cd, Cu, Pb, and Zn in Appendix D. Only one positive relationship was observed (for sulfate). Additional correlation was noted between the TDS content of the leachate and the sulfate content of the solid sample. This corroborates that sulfate is the dominant ion in the SPLP leachates. The lack of correlation indicates that, with the exception of sulfate, the chemical composition of the samples is not a reliable indicator for leachability. The general absence of correlation is probably caused by the heterogeneity of the materials present at the site.

Additional correlation was found between leachate constituents. Correlation between SPLP TDS, SPLP Ca, and SPLP sulfate is likely indicative of gypsum dissolution ($CaSO_4.2H_2O$). Similarly, correlation between SPLP F and SPLP Ca suggests that dissolution of fluorite (CaF_2) may be occurring. Correlation between SPLP Cu, SPLP Co, SPLP Ni, and SPLP Fe likely reflects the geochemical similarities of the former three metals, as well as adsorption of Cu, Co, and Ni onto iron (hydr)oxides. SPLP Zn and SPLP Cd likely correlate because cadmium readily substitutes for zinc in primary and secondary minerals.

Cadmium and zinc also correlate in terms of their concentrations in the total metals results. In addition, cobalt correlates well with the cadmium and zinc contents. Other correlations of note include calcium and the neutralizing potential (likely reflecting the presence of calcite, $CaCO_3$); iron and sulfide sulfur (pyrite, FeS_2); sulfide sulfur and sulfate sulfur (reflecting enhanced generation of oxidation products in the presence of reactive sulfides), and zinc and sulfide sulfur (sphalerite, ZnS).

All in all, the observed correlations can be explained in terms of simple geochemical and mineralogical principles. However, with the exception of the correlation between SPLP sulfate and the sulfate content of the mine materials, no correlations have any predictive value which would be useful in drawing further conclusions from the total metals results or as confirmatory screening analysis during implementation of any remedial action.

5.3 Volumes Estimates

Table 6 lists the elevations of contacts, as described in Section 5.1, that were used to deliniate the vertical extent of the various material encountered at the site. Table 7 lists the estimated volumes of soil cover material, potentially acidic material (material which contains acid generating and/or possibly acid generating, or stored acidity), and neutral material (materials which are not acid generating) at each stockpile, for the purpose of developing and comparing potential remedial alternatives.

The workplan (Golder, 2000) described methods of sampling and measuring layers controlling the potential release of acidity or metals, but layering was not encountered during the field investigation, except at Stockpile G1, where a neutral cap overlies acidic material. The limited stratigraphy observed within the stockpile materials was gradational or is irrelevant to removal options due to the acidity and potential leachability of materials in all layers. In some cases, the overlying soil cover is thick enough to be possibly salvaged and stockpiled during any removal of underlying stockpile material. In two cases, Stockpiles G2 and G4, the underlying soil and weathered or fractured bedrock were not acidic, and may be left in place during any removal of overlying stockpile material. In general, however, chemical analyses and field observations indicate that the stockpiles have a wide range of lithologies on a small scale, the stockpiles generally contain a mix of materials that are potentially acid producers, and have the potential to release metals to the environment. In addition, the behavior of the materials cannot be predicted by screening of total metals content or other simple laboratory analysis, as discussed in Section 5.2. This implies that segregation of materials which may have a low or possible potential to produce acid from those which are likely to produce acid is impractical.

For this reason, the volumes presented in Table 7 reflect the volume of material which would be practical to move if a removal action was selected as a remedy. The volume includes the soil cover, if it is thin or otherwise unsalvageable; the stockpile material; and the underlying soil and weathered or fractured bedrock where they are potential sources.

Figure 7 shows the estimated surface beneath each stockpile which represents material which is not impacted by acidity or a potential source of leachable metals. The ancestral topography is estimated on Figure 7 to aid in defining the target surface beneath each stockpile. However, the surface shown beneath each stockpile, and used for calculating volumes, is variably defined by either bedrock or the original surface, depending on the character of the materials. The volume estimate methods are summarized below for each stockpile. Calculation briefs are presented in Appendix E. Calculations were completed by digitizing the interpreted underlying surface and digitally subtracting the surface from the current topography. Figures 8 and 9 show the potential excavation surface in cross-section.

- Stockpile G1 - Volume estimates include the stockpile material below an elevation of 6,114 feet above mean sea level (the estimated base of the overlying neutral material) and the thin underlying soil/weathered bedrock (where present). The conglomerate material underlying the northern portion of the stockpile, which is not impacted, is not included in the volume. The underlying surface shown in Figure 7 would represent the bedrock and conglomerate. Approximately 30% of the stockpile is within the watershed of Bayard Canyon.
- Stockpile G2 - Volume estimates are given for both the stockpile material and the underlying soil. The underlying soil appears to be fairly unimpacted, but may contain some residual acidity. However, it is easily distinguished in the field and therefore could be left in place and reclaimed as a remedial option. Alternatively, it could be removed with the overlying stockpile to a different location as a second removal option. The volume excludes the soil cover on the southeastern portion of the stockpile.
- Stockpile G3 East - The volume includes the soil cover, stockpile material, and underlying soil/weathered bedrock.
- Stockpile G3 West - The volume includes stockpile material and underlying soil/weathered bedrock. While the upper interval and northern end of the stockpile are not as acidic as the rest of the stockpile, the change is gradational from a likely source to a possible or low potential source.
- Stockpile G4 - The volume includes the stockpile material only. The soil cover is salvageable and the underlying soil does not generate acid.

- Stockpile G5 - The volume includes the stockpile material and the underlying soil and channel deposits. While the stockpile material as a whole is probably not acid producing, any removal of the stored acidity in the underlying material would necessitate removal of the stockpile.
- Suspect Materials Area - The volume includes all materials below the soil cover to the bedrock surface. The bedrock was poorly defined in this area due to the presence of debris such as concrete and lumber. A bedrock surface was interpreted from surrounding topography and historical photographs.
- Foundations – Potentially acidic materials in the residential area (Figures 4 and 5) are limited to a wedge-shaped driveway approximately 300 feet long, averaging 5 feet thick on the slope and 10 feet wide. The volume was calculated as a triangular prism. There is minimal underlying soil in the area. Foundations in the suspect materials area are included in the volume calculations for that area.
- Roads - The only road identified as being separate from stockpiles and potentially acidic is the thin horizon of stored acidity beneath the paved road near the drainfield. The volume was calculated as an average thickness from the surface to a depth of 2 feet in the area adjacent to the drainfield. This volume assumes that the overlying layers of asphalt would be removed with the underlying material.

Potential errors in these estimates are associated with estimates of elevation and the lateral extent of the materials. These errors are generally governed by the error inherent in the topography (within 5 feet due to interpreted topographic contours) and the ability to estimate lateral contacts to within 10 feet due to the scale and accuracy of the working map. Surveying errors and errors in field measurements are very small compared to these limitations. A major uncertainty is the quality of the material adjacent to the pipeline. The overall error in the volume calculations is estimated at 20% or less, and is proportional to the size of the stockpile.

6. CONCLUSIONS

The site investigation was completed as outlined in Golder (2000). The purpose of the site characterization was to define the chemical nature and physical extent of mining-related materials sufficient for Chino to evaluate remedial options.

Stockpiles, roads, and foundations were chemically characterized based on their acid generating capacity and potential to leach metals and other indicator constituents. ABA and SPLP were used as screening analyses for these determinations, although both tests indicate the general potential for material behavior, and not necessarily the actual behavior of the material as it exists at the site.

The conclusions are detailed in Table 8 and summarized below:

- Chemical characterization of stockpiles indicates that acid generating materials occur in most of the stockpiles at the site. While the potential to generate acid varies within and between stockpiles, there are no stockpiles without the potential to generate acid. In addition, comparison of SPLP results to various groundwater and surface water standards shows that, while SPLP is a conservative screening test, there is some potential for metals to be released in excess of standards. The paved road near the drainfield and a fill driveway in the residential area also exhibit these characteristics.
- The lateral and vertical extent of material was defined for the purpose of estimating volumes for use in the comparison of potential remedial options. The total volume of materials which may require removal or containment, based on the chemical characterization and field observations is 186,000 per cubic yard (yd^3). Of this volume approximately 4,600 yd^3 are outside of the area contained by the new drainfield, either downgradient of the headwall (G4) or on the Bayard Canyon watershed (~30% of the lower interval of G1).
- The soil cover and underlying waste rock in the vegetation investigation area possess few inherent limitations with respect to supporting native and locally adapted vegetation. The soil and vegetation data are interpreted to indicate that adequate revegetation can be achieved with a 6- to 12-inch thick native soil cover placed over waste rock.
- Geotechnical samples were collected and archived for possible analysis of physical parameters related to stability of various configurations of the stockpiles under hypothetical removal scenarios.

- Seepage was not observed below the headwall during field activities.

The results of this characterization report will be used in the development of an Interim Remedial Action Workplan. The information collected during the field investigation and presented in this report will be used to evaluate existing source control structures and in the design and implementation of any additional remedial measures needed to prevent the discharge of impacted water to Whitewater Creek.

7. REFERENCES

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TABLES

TABLE 1
STOCKPILE, ROADBED, FOUNDATION, AND GEOTECHNICAL SAMPLES

Old Stockpile Identification	New Stockpile Identification	Test Pit Identification	Sample Interval	Sample Identification	Sample Date
G1	G1	G1-1	2'	U-03-52-24	6/15/00
		G1-1	4'	U-03-52-25	6/15/00
		G1-2	2'	U-03-52-21	6/15/00
		G1-2	4'	U-03-52-22	6/15/00
		G1-2	6'	U-03-52-23	6/15/00
		G1-3	2'	U-03-52-18	6/14/00
		G1-3	4'	U-03-52-19	6/14/00
		G1-3	6'	U-03-52-20	6/14/00
G2	G2	G2-1	2' - 6'	U-03-52-16	6/14/00
		G2-1	8'	U-03-52-17	6/14/00
		G2-2	2' - 10'	U-03-52-14	6/14/00
		G2-2	14'	U-03-52-15	6/14/00
G3	G3 East	G3-1	2' - 4'	U-03-52-11	6/13/00
		G3-1	8'	U-03-52-12	6/13/00
		G3-1	9'	U-03-52-13	6/13/00
	G3 West	G3-2	2' - 4'	U-03-52-07	6/13/00
		G3-2	6' - 8'	U-03-52-08	6/13/00
		G3-2	10' - 12'	U-03-52-09	6/13/00
		G3-2	16'	U-03-52-10	6/13/00
		G3-3	2'	U-03-52-04	6/13/00
		G3-3	4' -12'	U-03-52-05	6/13/00
		G3-3	16' -20'	U-03-52-06	6/13/00
		G3-4	2' - 6'	U-03-52-02	6/12/00
		G3-4	8' - 10'	U-03-52-03	6/12/00
G4	G4	G4-1	2' - 4'	U-03-52-30	6/20/00
		G4-1	6'	U-03-52-31	6/20/00
Suspect Materials	G3 West	EP-10	3'	U-03-52-42	6/22/00
G1	G1	EP-3	2'	U-03-52-26	6/15/00
G1	G1	EP-3	17'	U-03-52-27	6/16/00
G3	G3 East	EP-5	3'	U-03-52-28	6/16/00
G3	G3 East	EP-6	3'	U-03-52-29	6/16/00
G3	Suspect Materials	F1	2' - 4'	U-03-52-37	6/21/00
None	None	F2	2' - 5'	U-03-52-33	6/20/00
None	None	F3	2' - 4'	U-03-52-32	6/20/00
None	None	R1	2' - 16'	U-03-52-34	6/21/00
None	G5	R1	18'	U-03-52-35	6/21/00
None	G5	R1	20' (Hold)	U-03-52-36	6/21/00
None	None	R2	1' - 2'	U-03-52-38	6/21/00
None	None	R2	3'	U-03-52-39	6/21/00
None	None	R3	3" - 1'	U-03-52-40	6/21/00
None	None	R3	2'	U-03-52-41	6/21/00
None	None	R4	2' - 4'	U-03-52-43	6/22/00
G3	G3 West	EP-11	9.5'	EP-11-9.5[(a)]	6/22/00
G1	G1	EP-3	17'	EP-3-17[(a)]	6/16/00
None	G5	R1	12'	R-1-12[(a)]	6/21/00

[a] = Geotechnical Sample

TABLE 2
ANALYTICAL SUITES FOR
MINE-RELATED MATERIALS FROM THE GROUNDHOG MINE

Constituent	Total Metals[1]	SPLP[2]
Aluminum	X	X
Antimony	X	X
Arsenic	X	X
Cadmium	X	X
Calcium	X	X
Chromium	X	X
Cobalt	X	X
Copper	X	X
Iron	X	X
Lead	X	X
Magnesium	X	X
Manganese	X	X
Molybdenum	X	X
Nickel	X	X
Potassium	X	X
Sodium	X	X
Zinc	X	X
Total Dissolved Solids	---	X
Sulfate	---	X
Chloride	---	X
Fluoride	---	X
Total Number of Constituents	**17**	**21**

[1] Solids samples.

[2] Liquid extract from solids leached according to SPLP.

TABLE 5
SPLP RESULTS FOR MINE-RELATED MATERIALS FROM THE GROUNDHOG MINE

SAMPLE	PIT ID	DEPTH	Ca (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	Al (mg/L)	As (mg/L)	Cd (mg/L)	Co (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Sb (mg/L)	Zn (mg/L)	TDS (mg/L)	Cl (mg/L)	F (mg/L)	SO_4 (mg/L)
NM GW Standard for Human Health			NS	NS	NS	NS	NS	0.1	0.01	NS	0.05	NS	NS	NS	NS	NS	0.05	NS	NS	NS	NS	1.6	NS
Other NM GW Standard for Domestic Water Supply			NS	NS	NS	NS	NS	NS	NS	NS	NS	1.0	1.0	0.2	NS	NS	NS	NS	10	1000	250	NS	600
Other NM GW Standard for Irrigation Use			NS	NS	NS	NS	5.0	NS	NS	0.05	NS	NS	NS	NS	1.0	0.2	NS	NS	NS	NS	NS	NS	NS
NM Surface Water Standard[a]			NS	NS	NS	NS	5.0	0.1	0.01	0.1	0.1	0.1	NS	NS	1.0	0.2	0.1	NS	2.0	NS	NS	NS	NS
U03-52-42	EP-10	3'	369	3.3	11.5	2.9	0.026	<0.04	0.015	<0.006	<0.006	0.008	<0.02	0.379	<0.008	<0.024	<0.04	<0.05	0.771	1310	1.9	1.4	1080
U03-52-37	F1	2'-4'	12.1	<1.7	1.2	0.41	<0.024	<0.04	0.011	<0.006	<0.006	0.449	<0.02	0.335	<0.008	<0.024	1.44	<0.05	4.9	85	0.2	0.1	46.4
U03-52-33	F2	2'-5'	451	2.1	4.6	0.68	0.027	<0.04	0.234	0.031	<0.006	0.274	<0.02	7.48	0.008	<0.024	0.13	<0.05	79.8	1290	0.5	1.3	1440
U03-52-24	G1-1	2'	64.1	<1.7	15.5	0.2	12.9	<0.04	0.102	0.075	<0.006	13.1	17.8	11.2	<0.008	0.044	0.29	<0.05	17	1180	1.4	0.7	496
U03-52-25	G1-1	4'	53.3	<1.7	8.88	0.68	2.67	<0.04	0.029	0.027	<0.006	3.8	0.11	2.14	<0.008	<0.024	1.82	<0.05	5.38	375	0.6	0.5	235
U03-52-16	G2-1	2'-6'	41.9	2.2	6.48	1.31	<0.024	<0.04	0.024	<0.006	<0.006	0.018	<0.02	0.301	<0.008	<0.024	1.13	<0.05	3.66	195	0.6	0.2	140
U03-52-17	G2-1	8'	30.6	2.4	4.45	1.47	0.043	<0.04	0.003	<0.006	<0.006	0.008	0.04	0.204	<0.008	<0.024	<0.04	<0.05	0.732	230	0.4	0.2	94.9
U03-52-07	G3-2	2'-4'	369	2.3	4.04	0.4	0.031	<0.04	0.046	<0.006	<0.006	<0.003	<0.02	1.21	<0.008	<0.024	<0.04	<0.05	1.61	1390	<0.2	1.3	1030
U03-52-05	G3-3	4'-12'	534	2.7	18.5	0.28	11.9	<0.04	0.06	0.039	<0.006	1.69	0.03	15.9	<0.008	<0.024	0.71	<0.05	18.8	1870	0.6	2.5	1800
U03-52-30	G4-1	2'-4'	29.3	2.2	4.25	0.66	0.301	<0.04	0.006	<0.006	<0.006	0.072	<0.02	1.27	<0.008	<0.024	<0.04	<0.05	3.4	110	0.3	<0.1	112
U03-52-34	R1	2'-16'	486	3.2	7.53	0.53	0.03	<0.04	0.013	<0.006	<0.006	<0.003	<0.02	0.846	<0.008	<0.024	<0.04	<0.05	1.32	1250	<0.2	1.5	1320
U03-52-38	R2	1'-2'	545	1.8	2.31	0.5	2.67	<0.04	0.02	0.011	<0.006	0.153	0.02	2.74	<0.008	<0.024	0.15	<0.05	4.58	1640	<0.2	2	1630
U03-52-40	R3	3"-1'	65.5	<1.7	2.43	0.46	0.482	<0.04	0.01	0.009	<0.006	2.68	<0.02	1.82	<0.008	<0.024	2.97	<0.05	3.73	365	0.3	0.2	221
U03-52-43	R4	2'-4'	6.06	<1.7	2.34	2.63	0.166	<0.04	<0.002	<0.006	<0.006	0.005	0.07	0.007	<0.008	<0.024	<0.04	<0.05	0.029	60	<0.2	0.7	11.7
EXTRACTION FLUID			0.26	<1.7	<0.035	<0.12	<0.024	<0.04	<0.002	<0.006	<0.006	<0.003	<0.02	0.007	<0.008	<0.024	<0.04	<0.05	0.009	<10	<0.2	<0.1	3.5

Notes:
mg/L = milligrams per liter
NS = No Standard
< = concentration less than detection limit
NM = New Mexico
GW = Groundwater
[a] For perennial reaches of the Mimbres River downstream of the United States Geological Survey gaging station at Mimbres and all perennial reaches of tributaries thereto.

Exceeds both groundwater and surface water standards
Exceeds groundwater standards only
Exceeds surface water standards only

TABLE 4
TOTAL METALS ANALYSES FOR MINE-RELATED MATERIALS FROM THE GROUNDHOG MINE

Pit Identification	Sample Depth	Material Sampled	Sample Identification	Date of Sampling	Ca (mg/kg)	K (mg/kg)	Mg (mg/kg)	Na (mg/kg)	Al (mg/kg)	As (mg/kg)	Cd (mg/kg)	Co (mg/kg)	Cr (mg/kg)	Cu (mg/kg)	Fe (mg/kg)	Mn (mg/kg)	Mo (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)	Zn (mg/kg)
G1-1	2'	Mineralized cobbles, yellow/red clayey matrix, sulfur smell	U03-52-24	6/15/00	2,280	2,110	4,010	284	6,450	21.7	3.62	5.6	37.7	645	31,200	790	2.3	8.8	838	7	1,090
G1-1	4'	Underlying soil	U03-52-25	6/15/00	2,280	2,410	2,160	498	6,650	24	1.34	3.4	34.6	381	33,600	271	2.1	2.7	1,300	4.9	772
G1-2	2'	Limestone cobbles, yellowish clayey matrix	U03-52-21	6/15/00	124,000	1,440	3,390	152	5,520	9.3	11.8	3.5	25.4	380	13,800	607	2.4	7.3	1,900	6.1	3,490
G1-2	4'	Limestone and mineralized cobbles, yellow/gray gravelly sand matrix, secondary gypsum	U03-52-22	6/15/00	66,300	1,790	2,730	149	5,790	14.9	5.52	3.9	28.1	501	19,800	765	1.5	<2.3	1,930	4.3	1,640
G1-2	6'	Limestone and tuff cobbles, yellow/gray gravelly sand matrix, secondary gypsum	U03-52-23	6/15/00	108,000	1,860	5,440	198	10,900	8.9	17.2	5.1	13.7	177	15,100	879	0.9	4.9	905	4.7	5,000
G1-3	2'	Nonmineralized siliceous, mudstone, and tuff cobbles; gravelly sand and dark brown clay matrix	U03-52-18	6/14/00	1,950	1,930	805	124	3,500	32	1.15	2.8	39.1	805	25,900	536	33.7	2.3	11,000	4	544
G1-3	4'	Conglomerate	U03-52-19	6/14/00	5,080	1,820	5,030	164	11,900	11.4	<0.24	5.1	16.2	77	21,400	501	1	6.7	103	<3.2	175
G1-3	6'	Conglomerate	U03-52-20	6/14/00	5,230	1,790	4,470	183	10,500	7.1	0.67	12.1	20.5	84	22,200	1,240	1.4	9.2	239	<3.2	172
G2-1	2' - 6'	Mineralized and nonmineralized siliceous and tuff cobbles, light brown gravelly sand matrix	U03-52-16	6/14/00	3,300	1,550	2,060	110	5,420	24.2	3.07	4.6	34	850	18,800	1,840	29.9	4.5	19,600	4.6	1,520
G2-1	8'	Underlying soil	U03-52-17	6/14/00	4,180	1,600	2,240	100	8,770	18.7	7.89	5.3	27.9	258	17,000	895	2.8	6	2,010	6.6	1,040
G2-2	2' - 10'	Mineralized and nonmineralized siliceous and tuff cobbles, dark brown clayey gravel with sand matrix, secondary iron oxides in clay	U03-52-14	6/13/00	2,080	2,100	2,110	217	12,600	8.9	10.5	8.2	35.5	6,490	43,700	1,470	12.4	2.6	18,600	<3.2	3,470
G2-2	14'	Underlying soil	U03-52-15	6/14/00	5,730	1,310	895	65	4,530	<4.0	2.45	0.6	20.2	135	35,500	168	3.3	<2.3	591	<3.2	651
G3-1	2' - 4'	Mineralized siliceous cobbles, yellow gravelly sand with clay matrix, sulfur smell	U03-52-11	6/13/00	586	4,290	475	204	5,360	<4.0	1.9	4	48	1,180	43,500	251	5.8	<2.3	11,900	<3.2	500
G3-1	8'	Underlying soil	U03-52-12	6/13/00	5,320	1,500	5,050	40	14,600	<4.0	7.75	13.8	18.6	388	32,600	5,920	3.3	5.6	306	<3.2	1,470
G3-1	9'	Underlying parent rock	U03-52-13	6/13/00	5,090	1,710	5,520	52	13,500	<4.0	9.86	16.4	20.6	355	34,400	6,100	3.6	3.8	758	<3.2	1,840
G3-2	2' - 4'	Mineralized limestone, minor mineralized siliceous cobbles, orangish/light brown gravelly sand with clay matrix (reacts with HCl)	U03-52-07	6/13/00	28,400	2,140	8,180	122	12,000	<4.0	33.1	14	30.9	1,810	43,300	3,880	4.4	7.9	2,790	<3.2	13,700
G3-2	6' - 8'	Mineralized limestone and mineralized and nonmineralized siliceous cobbles, orangish/light brown gravelly sand with clay matrix	U03-52-08	6/13/00	9,970	2,310	2,860	227	6,610	<4.0	5.01	4.2	28	495	30,000	1,060	3.9	6.9	2,950	<3.2	2,060
G3-2	10' - 12'	Highly weathered granite (moldable)	U03-52-09	6/13/00	9,270	2,690	6,520	204	10,700	<4.0	5.11	10.8	19.7	372	36,000	3,040	2.4	9.3	919	<3.2	2,600
G3-2	16'	Underlying soil	U03-52-10	6/13/00	4,550	1,470	6,370	51	22,700	<4.0	4.87	7.2	14.4	800	25,300	2,199	2.4	3.6	432	<3.2	2,850
G3-3	2'	Mineralized limestone, minor mineralized siliceous cobbles, gray/light brown gravelly sand with clay matrix (reacts with HCl)	U03-52-04	6/13/00	50,500	1,350	6,340	85	10,200	5	35.5	24.8	39.2	4,090	61,200	3,630	4.1	15.8	3,840	<3.2	17,700
G3-3	4' -12'	Mineralized limestone and mineralized and nonmineralized siliceous cobbles, orangish/light brown gravelly sand with clay matrix (secondary gypsum at 12')	U03-52-05	6/13/00	20,700	2,600	4,740	150	9,160	<4.0	3.06	4.9	16.5	429	56,900	2,170	3.1	3.8	2,640	<3.2	1,180
G3-3	16' -20'	Granitic cobbles, sandy gravel matrix with clay lenses	U03-52-06	6/13/00	19,400	2,660	4,860	74	10,900	<4.0	12.3	13.2	21.9	736	24,100	4,850	3	6	857	<3.2	4,170
G3-4	2' - 6'	Mineralized limestone, minor mineralized siliceous cobbles, brown sand with clay matrix, iron staining (reacts with HCl)	U03-52-02	6/12/00	42,100	1,850	5,810	173	10,600	<4.0	24.2	16.5	33.4	1,760	43,500	4,030	3.3	7.9	2,220	<3.2	14,600
G3-4	8' - 10'	Mineralized limestone, mudstone, and granitic cobbles; brown sand matrix with clay lenses (original surface?)	U03-52-03	6/14/00	20,700	2,010	7,110	113	14,700	<4.0	11.6	15.6	21.2	888	30,900	4,790	3.7	4.7	1,460	<3.2	4,750
G4-1	2' - 4'	Mineralized siliceous cobbles, yellow gravelly sand with clay matrix (weathered granite)	U03-52-30	6/20/00	2,020	4,410	6,610	41	12,500	17	<0.24	4.8	63.7	75	28,400	4,260	3.7	<2.3	1,630	<3.2	1,930
G4-1	6'	Underlying soil	U03-52-31	6/20/00	4,380	2,520	5,290	156	23,000	<4.0	1.86	3.7	32.8	421	20,300	979	1.6	6.7	538	3.5	1,130
EP-10	3'	Limestone, tuff, mineralized, and nonmineralized siliceous cobbles; light brown gravelly sand with clay matrix (reacts with HCl)	U03-52-42	6/22/00	51,100	2,210	5,130	179	11,500	21.8	61.6	19.5	53.4	1,820	39,200	3,620	2.3	11.4	12,100	<3.2	26,100
EP-3 (G-1)	2'	Mineralized siliceous cobbles, yellow clayey sand, sulfur smell, highly mineralized, sampled discretely from wall (worst-case sample)	U03-52-26	6/15/00	1,320	2,650	235	115	2,530	36.4	1.34	9.7	25.1	1,650	59,400	97	6.4	<2.3	16,300	3.6	594
EP-3 (G-1)	17'	Conglomerate	U03-52-27	6/16/00	4,920	2,170	4,410	113	11,300	11.4	16.4	11	16.5	1,390	19,900	810	1.5	11	325	5.7	3,360
EP-5 (G-3 east)	3'	Mixed fill (orangish brown clayey gravel) and mineralized siliceous cobbles, yellow gravelly sand with clay matrix, sulfur smell	U03-52-28	6/16/00	3,420	4,060	4,380	93	8,140	27.4	10.6	7.6	31.2	1,120	39,600	2,510	3.2	6.6	3,520	4.3	2,370
EP-6 (G-3 east)	3'	Mineralized siliceous and nonmineralized granitic cobbles, yellow gravelly sand with clay matrix (sampled because grass grows on this portion of San Jose Shaft hillside)	U03-52-29	6/16/00	2,370	2,180	3,310	191	8,050	9.3	4.58	6.3	30.5	1,360	20,200	1,340	2.5	4.2	1,150	<3.2	1,560
F1	2' - 4'	Siltstone cobbles with chert, brown sandy gravel matrix	U03-52-37	6/21/00	3,110	2,200	2,120	117	7,160	25.7	11.9	6.1	43	3,440	35,200	1,880	3.8	<2.3	13,800	<3.2	5,100
F2	2' - 5'	Mineralized and nonmineralized granitic and other siliceous cobble matrix, iron-stained sand, brown clay lenses	U03-52-33	6/20/00	17,600	2,350	9,540	53	20,000	14	40.3	11.1	81.6	450	30,900	5,570	2.4	9.5	963	<3.2	12,600
F3	2' - 4'	Conglomerate	U03-52-32	6/20/00	5,720	2,420	5,650	497	13,300	13	<0.24	7.4	28.7	20	21,400	904	<0.8	10.3	80	<3.2	219
R1 (G5)	2' - 16'	Mineralized and nonmineralized limestone and minor granitic cobbles, gray and orangish gravelly sand with clay matrix (reacts with HCl)	U03-52-34	6/21/00	77,500	2,550	6,570	103	10,000	27.1	26.2	14.7	60.7	455	38,200	3,820	2.5	9.7	2,630	<3.2	9,060
R1 (G5)	18'	Underlying soil	U03-52-35	6/21/00	3,600	2,260	3,250	157	14,400	25.6	5.34	5	34.9	1,530	37,900	878	1.9	5.2	1,650	<3.2	2,270
R2 (G5)	1' - 2'	Mineralized and nonmineralized granitic and other siliceous cobble matrix, yellowish stained gravelly matrix	U03-52-38	6/21/00	8,560	2,460	4,680	71	9,290	28.9	1.05	7.2	31.5	193	36,400	1,740	1.5	2.6	940	<3.2	942
R2 (G5)	3'	Underlying soil	U03-52-39	6/21/00	5,300	3,260	6,530	99	31,000	<4.0	3.12	13.7	27.8	244	25,000	1,930	2	12.7	147	<3.2	1,350
R3	3" - 1'	Siltstone with chert and granitic cobbles, light brown to yellowish brown sandy matrix	U03-52-40	6/21/00	3,050	1,380	2,370	144	6,360	23.9	1.79	5.6	39.3	1,360	28,500	2,660	9.9	3.1	5,990	<3.2	1,250
R3	2'	Underlying soil	U03-52-41	6/21/00	3,590	2,080	5,780	51	12,700	10.1	3.24	8	28.5	115	22,700	4,350	2.1	3.1	1,100	<3.2	1,710
R4	2' - 4'	Grayish brown fractured granite	U03-52-43	6/22/00	6,260	1,850	8,500	49	14,900	4.8	3.98	9.4	36.8	26	19,400	4,920	2.1	6.2	545	<3.2	1,490

Notes:
mg/kg = milligrams per kilograms

TABLE 3
ACID-BASE ACCOUNTING RESULTS FOR MINE-RELATED MATERIALS FROM THE GROUNDHOG MINE

Pit Identification	Sample Depth	Material Sampled	Sample Identification	Paste pH	Net Neutralizing Potential	NP/AP	NP[a]	AP[a]	Total Sulfur %	Pyritic Sulfur %	Sulfate %	Non-Extractable Sulfur %	Material Classification
G1-1	2'	Mineralized cobbles, yellow/red clayey matrix, sulfur smell	U03-52-24	3.06	-22.5	<0.02	<0.5	22.5	1.69	0.72	0.92	0.05	Likely to Generate Acid
G1-1	4'	Underlying soil	U03-52-25	3.84	-14.4	<0.03	<0.5	14.4	1.03	0.46	0.56	0.01	Likely to Generate Acid
G1-2	2'	Limestone cobbles, yellowish clayey matrix	U03-52-21	7.75	346	183.2	348	1.9	0.5	0.06	0.41	0.03	Not Acid Generating
G1-2	4'	Limestone and mineralized cobbles, yellow/gray gravelly sand matrix, secondary gypsum	U03-52-22	7.54	155	20.1	163	8.1	0.55	0.26	0.26	0.03	Not Acid Generating
G1-2	6'	Limestone and tuff cobbles, yellow/gray gravelly sand matrix, secondary gypsum	U03-52-23	7.82	295	43.8	302	6.9	0.56	0.22	0.15	0.19	Not Acid Generating
G1-3	2'	Nonmineralized siliceous, mudstone, and tuff cobbles; gravelly sand and dark brown clay matrix	U03-52-18	3.78	-6.9	<0.1	<0.5	6.9	1.08	0.22	0.77	0.09	Stored acidity
G1-3	4'	Conglomerate	U03-52-19	5.24	4.1	14.7	4.4	0.3	0.03	0.01	0.02	<0.01	Not Acid Generating
G1-3	6'	Conglomerate	U03-52-20	5.74	4.8	9.0	5.4	0.6	0.05	0.02	0.03	<0.01	Not Acid Generating
G2-1	2' - 6'	Mineralized and nonmineralized siliceous and tuff cobbles, light brown gravelly sand matrix	U03-52-16	6.43	-4.7	0.3	1.9	6.6	0.59	0.21	0.32	0.06	Possibly Acid Generating
G2-1	8'	Underlying soil	U03-52-17	5.54	-6	0.2	1.5	7.5	0.43	0.24	0.18	0.01	Possibly Acid Generating
G2-2	2' - 10'	Mineralized and nonmineralized siliceous and tuff cobbles, dark brown clayey gravel with sand matrix, secondary iron oxides in clay	U03-52-14	4.67	18.6	1.7	46.7	28.1	1.35	0.9	0.4	0.05	Possibly Acid Generating
G2-2	14'	Underlying soil	U03-52-15	6.92	8.4	4.4	10.9	2.5	0.18	0.08	0.08	0.02	Not Acid Generating
G3-1	2' - 4'	Mineralized siliceous cobbles, yellow gravelly sand with clay matrix, sulfur smell	U03-52-11	3.18	-53.4	<0.01	<0.5	53.4	3.11	1.71	1.36	0.04	Likely to Generate Acid
G3-1	8'	Underlying soil	U03-52-12	3.93	-1.9	<0.3	<0.5	1.9	0.53	0.06	0.47	<0.01	Stored acidity
G3-1	9'	Underlying parent rock	U03-52-13	3.98	7.4	2.8	11.5	4.1	0.63	0.13	0.49	0.01	Low Potential to Generate Acid
G3-2	2' - 4'	Mineralized limestone, minor mineralized siliceous cobbles, orangish/light brown gravelly sand with clay matrix (reacts with HCl)	U03-52-07	7.42	-26.6	0.6	44.3	70.9	3.54	2.27	1.24	0.03	Likely to Generate Acid
G3-2	6' - 8'	Mineralized limestone and mineralized and nonmineralized siliceous cobbles, orangish/light brown gravelly sand with clay matrix	U03-52-08	5.7	-22.1	0.2	4.2	26.3	1.75	0.84	0.89	0.02	Likely to Generate Acid
G3-2	10' - 12'	Highly weathered granite (moldable)	U03-52-09	4.96	-13.1	0.2	2.5	15.6	1.36	0.5	0.84	0.02	Likely to Generate Acid
G3-2	16'	Underlying soil	U03-52-10	4.12	-0.3	<1.7	<0.5	0.3	0.43	0.01	0.4	0.02	Stored acidity
G3-3	2'	Mineralized limestone, minor mineralized siliceous cobbles, gray/light brown gravelly sand with clay matrix (reacts with HCl)	U03-52-04	7.38	20.1	1.2	116	95.9	4.47	3.07	1.29	0.11	Possibly Acid Generating
G3-3	4' -12'	Mineralized limestone and mineralized and nonmineralized siliceous cobbles, orangish/light brown gravelly sand with clay matrix (secondary gypsum at 12')	U03-52-05	5.17	-37.4	0.2	9.5	46.9	3.69	1.5	2.17	0.02	Likely to Generate Acid
G3-3	16' -20'	Granitic cobbles, sandy gravel matrix with clay lenses	U03-52-06	6.5	3.2	1.1	26	22.8	2.01	0.73	1.26	0.02	Possibly Acid Generating
G3-4	2' - 6'	Mineralized limestone, minor mineralized siliceous cobbles, brown sand with clay matrix, iron staining (reacts with HCl)	U03-52-02	7.31	33.5	1.6	91.6	58.1	3.05	1.86	1.16	0.03	Possibly Acid Generating
G3-4	8' - 10'	Mineralized limestone, mudstone, and granitic cobbles; brown sand matrix with clay lenses (original surface?)	U03-52-03	6.57	21.9	2.5	36.9	15	1.16	0.48	0.66	0.02	Low Potential to Generate Acid
G4-1	2' - 4'	Mineralized siliceous cobbles, yellow gravelly sand with clay matrix (weathered granite)	U03-52-30	4.37	-13.2	<0.04	<0.5	13.2	0.83	0.42	0.4	<0.01	Likely to Generate Acid
G4-1	6'	Underlying soil	U03-52-31	4.27	-0.3	<1.7	<0.5	0.3	0.21	0.01	0.17	0.03	Stored acidity
EP-10 (G3 west)	3'	Limestone, tuff, mineralized, and nonmineralized siliceous cobbles; light brown gravelly sand with clay matrix (reacts with HCl)	U03-52-42	7.29	41.3	1.5	126	84.7	4.55	2.71	1.22	0.62	Possibly Acid Generating
EP-3 (G-1)	2'	Mineralized siliceous cobbles, yellow clayey sand, sulfur smell, highly mineralized, sampled discretely from wall (worst-case sample)	U03-52-26	2	-113	<0.004	<0.5	113	6.42	3.63	2.5	0.29	Likely to Generate Acid
EP-3 (G-1)	17'	Conglomerate	U03-52-27	4.42	1.5	2.7	2.4	0.9	0.26	0.03	0.23	<0.01	Stored acidity
EP-5 (G-3 east)	3'	Mixed fill (orangish brown clayey gravel) and mineralized siliceous cobbles, yellow gravelly sand with clay matrix, sulfur smell	U03-52-28	3.85	-37.2	<0.01	<0.5	37.2	2.54	1.19	1.33	0.02	Likely to Generate Acid
EP-6 (G-3 east)	3'	Mineralized siliceous and nonmineralized granitic cobbles, yellow gravelly sand with clay matrix (sampled because grass grows on this portion of San Jose Shaft hillside)	U03-52-29	4.32	-3.8	<0.1	<0.5	3.8	0.45	0.12	0.31	0.02	Stored acidity
F1	2' - 4'	Siltstone cobbles with chert, brown sandy gravel matrix	U03-52-37	6.23	-18.9	0.2	3.9	22.8	1.3	0.73	0.45	0.12	Likely to Generate Acid
F2	2' - 5'	Mineralized and nonmineralized granitic and other siliceous cobble matrix, iron-stained sand, brown clay lenses	U03-52-33	6.34	3	1.2	22.1	19.1	1.7	0.61	1.04	0.05	Possibly Acid Generating
F3	2' - 4'	Conglomerate	U03-52-32	7.51	8	>26.7	8	<0.3	0.04	<0.01	0.04	<0.01	Not Acid Generating
R1 (G-5)	2' - 16'	Mineralized and nonmineralized limestone and minor granitic cobbles, gray and orangish gravelly sand with clay matrix (reacts with HCl)	U03-52-34	7.32	123	2.6	198	75.3	3.31	2.41	0.73	0.17	Low Potential to Generate Acid
R1 (G5)	18'	Underlying soil	U03-52-35	5.14	-9.1	<0.1	<0.5	9.1	0.8	0.29	0.46	0.05	Stored acidity
R2 (G5)	1' - 2'	Mineralized and nonmineralized granitic and other siliceous cobble matrix, yellowish stained gravelly matrix	U03-52-38	5.49	-14.7	0.4	10	24.7	1.9	0.79	1.08	0.03	Likely to Generate Acid
R2 (G5)	3'	Underlying soil	U03-52-39	4.14	-0.3	<1.7	<0.5	0.3	0.31	0.01	0.3	<0.01	Stored acidity
R3	3" - 1'	Siltstone with chert and granitic cobbles, light brown to yellowish brown sandy matrix	U03-52-40	4.39	-2.7	0.5	2.6	5.3	0.61	0.17	0.39	0.05	Stored acidity
R3	2'	Underlying soil	U03-52-41	6.53	4.3	>14.3	4.3	<0.3	0.16	<0.01	0.13	0.03	Not Acid Generating
R4	2' - 4'	Grayish brown fractured granite	U03-52-43	7.78	14.9	>49.7	14.9	<0.3	<0.01	<0.01	<0.01	<0.01	Not Acid Generating

Notes:
[a] = units are Kg of $CaCO_3$ per ton material
NP = Neutralizing Potential
AP = Acid Potential

TABLE 6
TEST PIT LITHOLOGIC UNIT CONTACT ELEVATIONS

Test Pit Identification	Surface Elevation (feet amsl)	Soil Cover Contact (average)		Contact with Underlying Soil Surface		Contact with Weathered Bedrock		Refusal (Bedrock Contact)		Additional Layering and Field Observations
		Depth (feet bgs)	Elevation (feet amsl)	Depth (feet bgs)	Elevation (feet amsl)	Depth (feet bgs)	Elevation (feet amsl)	Depth (feet bgs)	Elevation (feet amsl)	
EP-1	6096.4	0.75	6095.65	No soil		4	6092.4	4.5	6091.9	None
EP-2	6085.6	0	6085.6	No soil		9	6076.6	20	6065.6	None
EP-3	6103.7	0.33	6103.37	13	6090.7	None		>23	<6080.7	Conglomerate at 13'.
EP-4	6092.1	3	6089.1	13	6079.1	18	6074.1	>21.5	<6070.6	No yellow clay below 6', conglomerate 14'-18', with mixed conglomerate/weathered bedrock below. Surface cover is road fill.
EP-5	6065.7	1.25	6064.45	No soil		7	6058.7	12	6053.7	4' to 6' - cobble layer. Toe of old dump.
EP-6	6094.2	1.25	6092.95	None		11	6083.2	11.5	6082.7	None
EP-7	6062.3	Not Recorded		5	6057.3	11	6051.3	14.5	6047.8	Rubble/wires to 3', LS cobbles to 5'.
EP-8	6001.9	1	6000.9	Variable (clean)		1.5	6000.4	5.5	5996.4	Stockpile pinches out.
EP-9	6059.4	0.5	6058.9	12	6047.4	12	6047.4	15	6044.4	Gypsum below 12'.
EP-10	6041.2	0.25	6040.95	3.5	6037.7	Mixed with rubble above		6.17	6035.03	Rubble/debris below 3.5'.
EP-11	6054.3	1.5	6052.8	None		None		>10	<6044	Moist, weathered below 9'. Gypsum throughout.
EP-12	6059.9	2	6057.9	2	6057.9	3	6056.9	5	6054.9	No stockpile material.
EP-13	6058.8	0.25	6058.55	0.25	6058.55	7	6051.8	8.33	6050.47	No stockpile material.
EP-14	6049.1	1	6048.1	5	6044.1	None			<6041	Original surface mixed with rubble below 5'. Buried concrete prevented digging below 8'.
F1	6066.3	1.08	6065.22	7	6059.3	7.5	6058.8	10	6056.3	Limestone cobbles below cover to 2'.
F2	6081.5	None		None		5	6076.5	6	6075.5	None
F3	6107	2	6105	2	6105	None		5.33	6101.67	Foundation material is conglomerate.
G1-1	6106.3	0.67	6105.63	None		4.5	6101.8	4.5	6101.8	None
G1-2	6121	1.67	6119.33	None		None		7	6114	Gypsum below 3.5'.
G1-3	6095.6	4	6091.6	4	6091.6	None		None	<6072	Conglomerate at 4'.
G2-1	6082.9	1.25	6081.65	7.5	6075.4	9.5	6073.4	9.5	6073.4	None
G2-2	6077.9	none		12	6065.9	14	6063.9	14	6063.9	None
G3-1	6080.9	0.42	6080.48	6	6074.9	9	6071.9	9	6071.9	Colluvium from 6.5'-9' (under original soil).
G3-2	6064.3	0.67	6063.63	15	6049.3	17	6047.3	17	6047.3	Weathered granite from 10'-15' (fill over old surface). Gypsum below 12'.
G3-3	6057.3	0.75	6056.55	None		15	6042.3	20	6037.3	Gypsum below 12'.
G3-4	6046.3	1	6045.3	7	6039.3	None		11.5	6034.8	None
G4-1	6007.9	1.5	6006.4	6	6001.9	6	6001.9	6	6001.9	Gypsum at ~6'.
R1	6058.5	0.16	6058.34	17	6041.5	None		23	6035.5	Gypsum below 14'-18'. Cover is roadfill. Gypsum at 12' Channel deposits below 17'.
R2	6071.1	0.58	6070.52	2.5	6068.6	5	6066.1	7	6064.1	Cover is 2"asphalt, 3" old asphalt, 2" Limestone.
R3	6027.9	0.16	6027.74	1	6026.9	3	6024.9	4.5	6023.4	Cover is asphalt.
R4	6042.1	None			6042.1	0	6042.1	6	6036.1	None

Notes:
amsl = above mean sea level
bgs = below ground surface

TABLE 7
ESTIMATED VOLUMES AND AREAS OF MINE-RELATED MATERIALS AT THE GROUNDHOG MINE

Stockpile Identification	Area of Ground Surface		Total Volume of Mining Material		Volume of Cover Soil		Volume of Potentially Acidic Materials[a]		Volume of Materials That Do Not Generate Acid		Notes
	($feet^2$)	(acres)	($feet^3$)	($yards^3$)	($feet^3$)	($yards^3$)	($feet^3$)	($yards^3$)	($feet^3$)	($yards^3$)	
G1	54,422	1.25	468,126	17,338	54,422	2,016	317,962	11,776	95,742	3,546	Material at top of stockpile is not acid generating (30% acidic material in Bayard Canyon watershed)
G2	40,210	0.92	601,290	22,270	16,754	621	504,116	18,671	80,420	2,979	Salvagable soil cover 1.25' thick over 30% of Area, 2' underlying soil may be left in place.
G3 East	59,109	1.36	512,892	18,996	18,472	684	494,420	18,312	0	0	No salvagable soil cover for stockpiling
G3 West	167,157	3.84	1,956,582	72,466	167,157	6,191	1,789,425	66,275	0	0	None
G4	15,233	0.35	44,010	1,630	15,233	564	28,777	1,066	0	0	Underlying Soil can be left in place
G5	31,128	0.71	492,588	18,244	24,902	922	467,686	17,322	0	0	None
Suspect Material	102,994	2.36	1,470,717	54,471	102,994	3,815	1,367,723	50,656	0	0	None
Foundations (residential)	NA	NA	7,506	278	NA	NA	7,506	278	0	0	Driveway sampled by F3
Roadbed	22,203	0.51	44,406	1,645	0	0	44,406	1,645	0	0	None
				Total Volumes:	**399,934**	**14,812**	**5,022,021**	**186,001**	**176,162**	**6,525**	None

Notes:

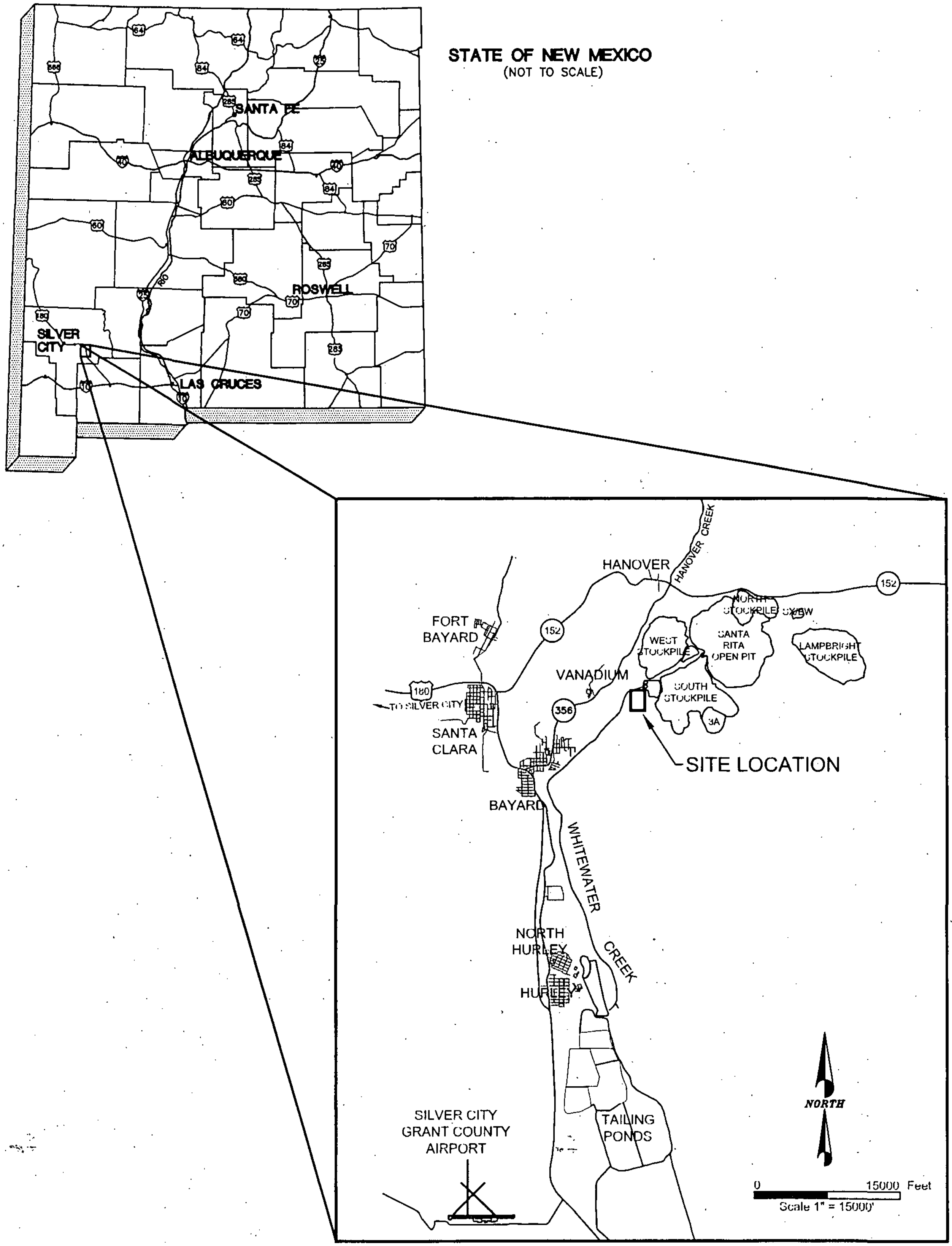
[a] = "Potentially Acidic Materials" include materials in which sample results indicate the presence of materials which are "likely to generate acidic" or "possibly acid generating", as defined in Table 4.

TABLE 8
SUMMARY OF RESULTS OF CHARACTERIZATION OF THE GROUNDHOG MINE

Location Identification	Potentially Leachable Metals[a]	Acid Production Potential	Field Observations	Estimated Volume of Potentially Acidic Materials (yd^3)	Contained (Upgradient of Drainfield)
G1	Al, Cd, Co, Cu, Fe, Mn, Pb, and Zn	Not acid generating in upper portion; likely to generate acid in lower portion; underlying materials in northern portion are not impacted by pile.	Infrastructure includes the new road, Chino pipelines, telemetry station, and power lines. Yellow material has a sulfur smell.	11,776	Yes
G2	Cd, Mn, Pb, and Zn	Stockpile material is possibly acid generating; underlying materials are not acid generating.	Underlying soil is not acid generating, but slightly mixed with the stockpile material in places and difficult to distinguish from overlying materials. New road and fiber optics cable cut stockpile.	18,671 to 21,650[b]	Yes
G3 East	Assumed similar to lower interval of G1	Stockpile material and underlying soil/weathered bedrock is likely to generate acid or contains stored acidity.	Soil cover on western portion of hillside does not support vegetation.	18,312	Yes
G3 West	Al, Cd, Cu, Fe, Mn, Pb, and Zn	Stockpile grades from possibly acid generating in the upper portion and the northern portion to "likely to generate acidity" in the lower southern portion; underlying soil at the northern end of the stockpile is not acid generating but become possibly acidic to the south.	Underlying soil which is not acid generating and difficult to distinguish from overlying materials with more acidic underlying soil to the south. Roads, power lines, and the Chino pipeline cross the stockpile.	66,275	Yes
G4	Mn and Zn	Stockpile material is likely to generate acid; underlying materials contain some stored acidity, but is not acid generating.	Underlying soil is thin (< 1 foot) and contain very little pyrite sulfur.	1,066	No
G5	Cd and Mn	Stockpile material has a low potential to generate acid in the thick northern portion and is likely to generate acid in the thin southern portion; underlying soil and channel deposits contain stored acidity.	Underlying channel deposits occur at the northern portion located in the center line of the ancestral drainage. These deposits were saturated in thin silty intervals. Power lines and roads cross the stockpile.	17,283	Yes
Suspect Materials	Assumed similar to lower interval of G1	This material was not subjected to ABA, but was lithologically similar to acidic materials at G1.	Debris is present in the lower interval. Power lines, the Chino pipeline, and fiber optics cable cross the area.	50,656	Yes
Foundations (residential)	Cd, Cu, Mn, Pb, and Zn	One driveway fill area was identified as possibly acid generating. Other areas were non-mineralized.	Housing footings are filled with conglomerate (pea gravel), driveways are crushed rock.	278	Yes
Roadbed Near Drainfield	Cu, Mn, Pb, and Zn	A thin horizon of material beneath the asphalt and adjacent to the drainfield contains stored acidity.	Acidic material is overlain by asphalt and limestone roadfill.	1,645	Yes

Notes:
a = Based on a comparison of SPLP results with potentially applicable groundwater and surface water standards.
b = Range of volumes depends on whether the 2 foot interval of underlying soil and weathered bedrock would be removed along with the stockpile material.
yd^3 = cubic yards

FIGURES



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PROJECT NO.	DATE	REVISION
003-2562	10/09/00	A

FIGURE 1

Groundhog Mine Site Location

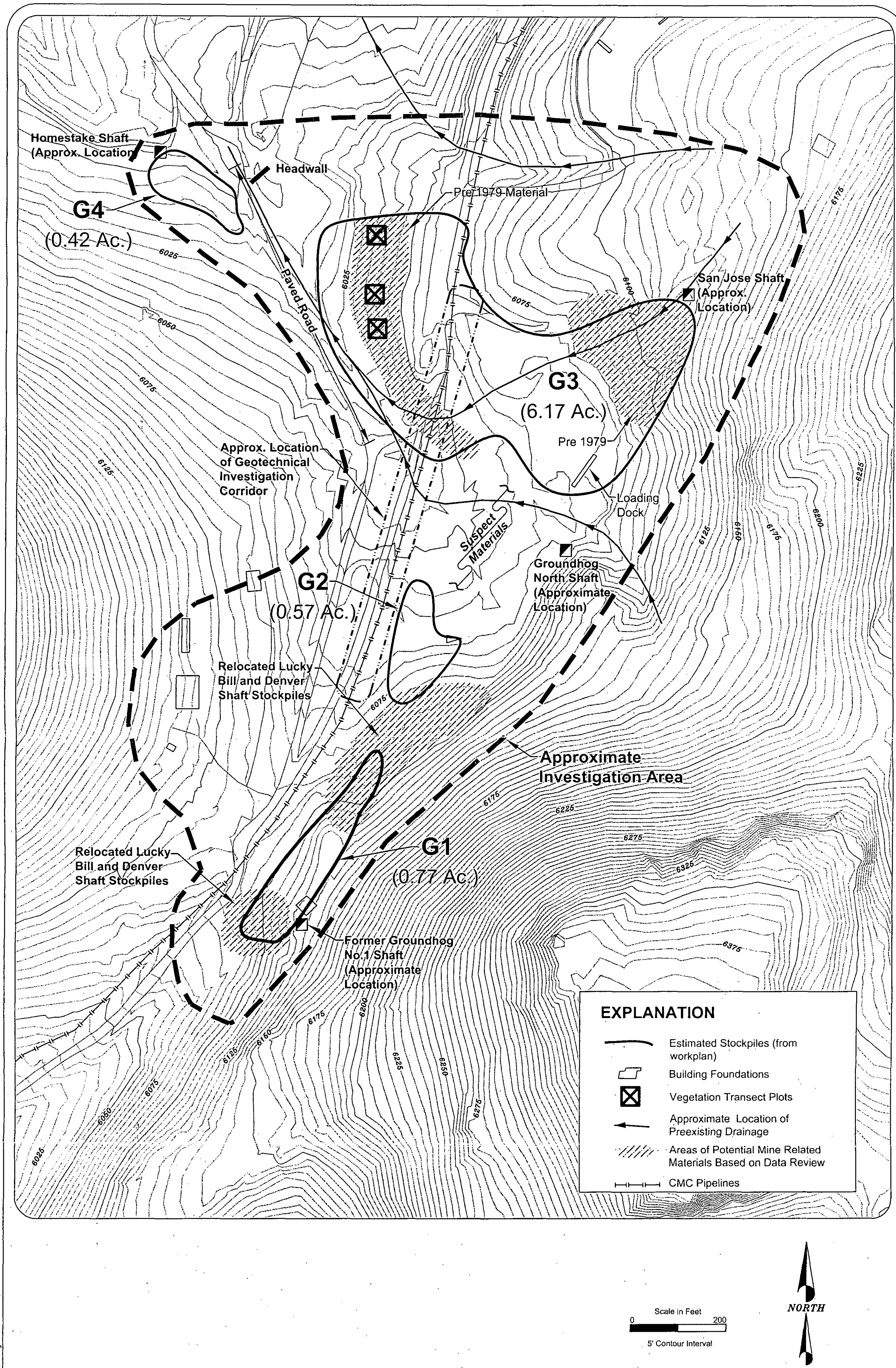

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FIGURE 2

Estimated Stockpile Locations Prior to Field Investigation

PROJECT NO.	CLIENT	PROJECT	REVISION	DATE	SCALE
003-2562	Chino Mines Company	Groundhog Site Investigation	A	10/09/00	1"=200'

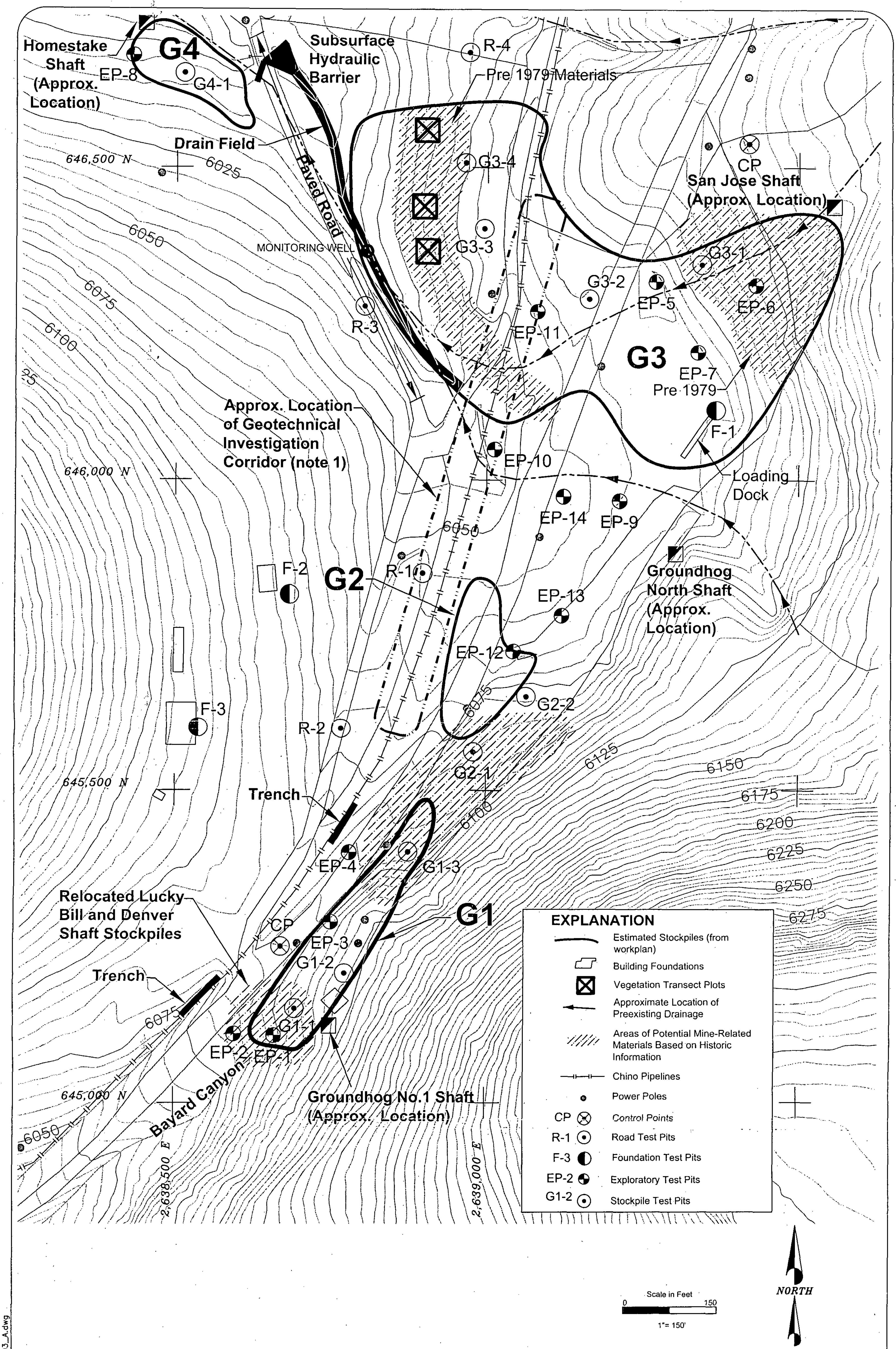

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FIGURE 3

June 2000 Test Pit Locations - Groundhog Mine

PROJECT NO.	CLIENT	PROJECT	REVISION	DATE	SCALE
003-2562	Chino Mines Company	Groundhog Site Investigation	A	10/09/00	1"= 150'

NOTE

1. Photograph has not been corrected for distortion and therefore images may appear different from images ploted on the topographic map.

Explanation

Direction of Surface Water Flow

Approx. Scale in Feet
0 200

NORTH

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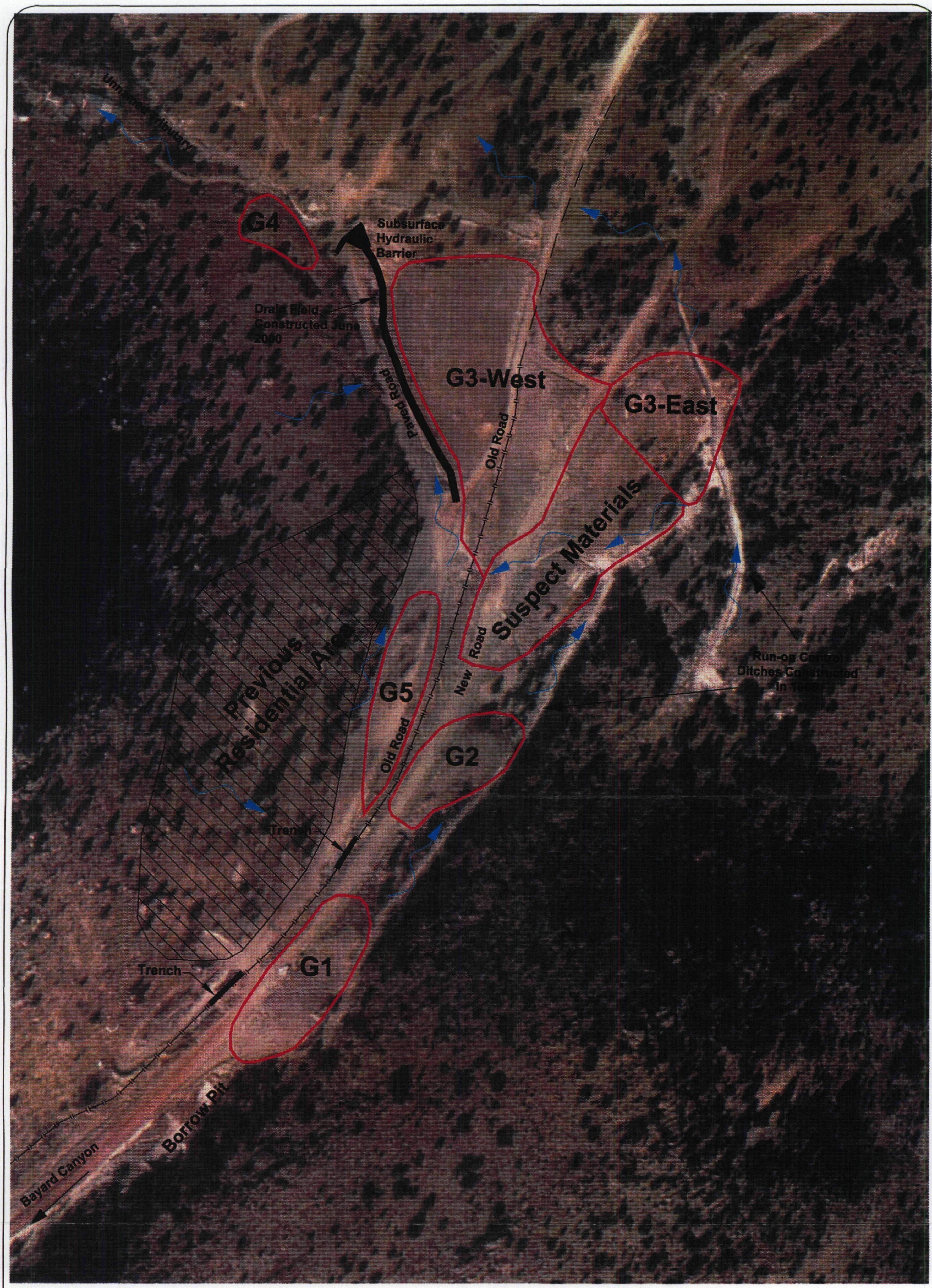
FIGURE 4
Vertical Aerial Photograph - 1979

PROJECT NO.	CLIENT	PROJECT	REVISION	DATE	SCALE
003-2562	Chino Mines Company	Groundhog Site Investigation	A	10/09/00	1"=200'



NOTE

1. Photograph has not been corrected for distortion and therefore images may appear different from images piloted on the topographic map.

Explanation

Direction of Surface Water Flow

Approx. Scale in Feet
0 200

NORTH

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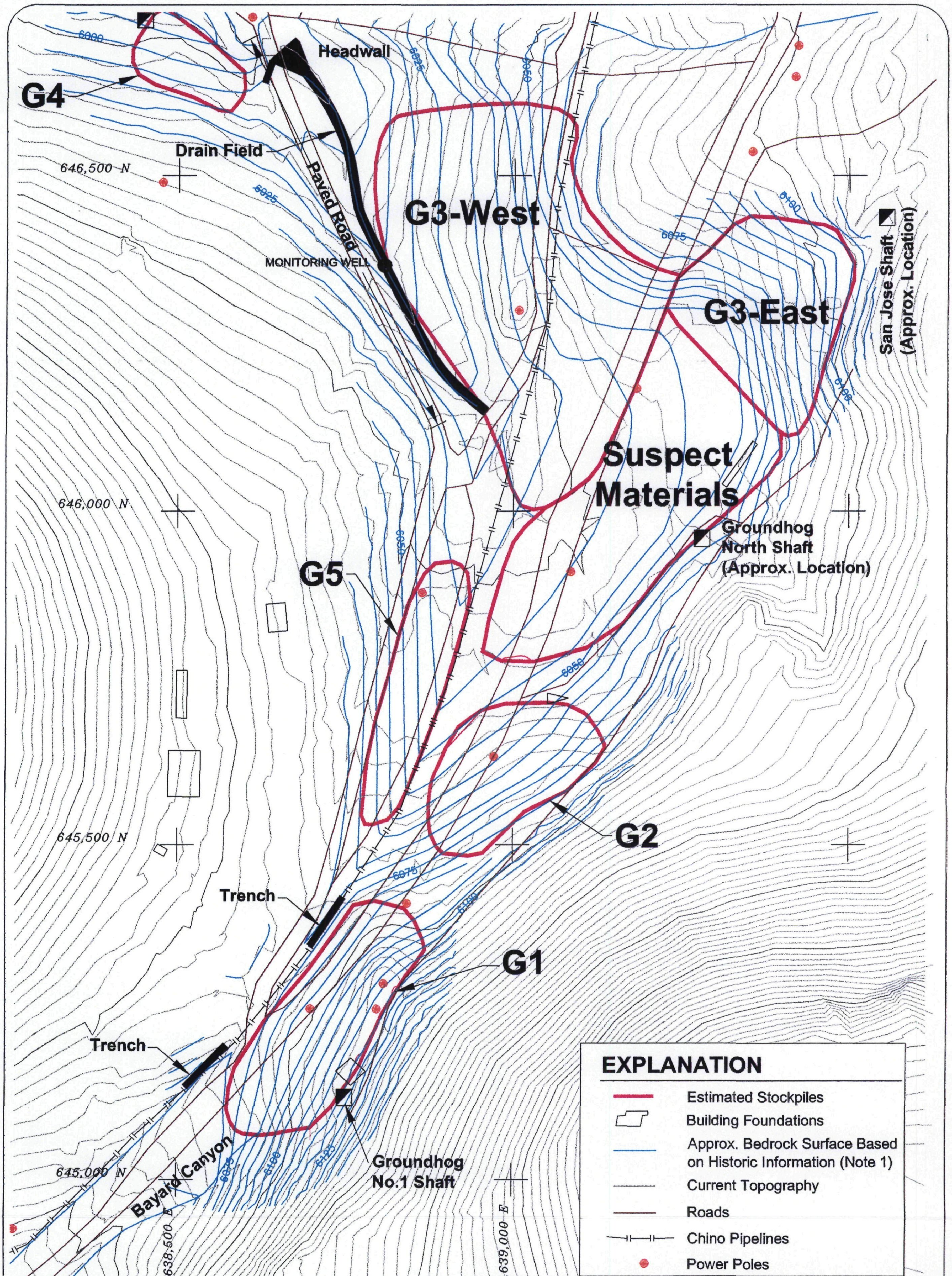
FIGURE 5
Vertical Aerial Photograph - 1999

PROJECT NO.	CLIENT	PROJECT	REVISION	DATE	SCALE
003-2562	Chino Mines Company	Groundhog Site Investigation	A	10/09/00	1"=200'



NOTE

1. The surface beneath the stockpiles may represent either the bedrock or the depth to the original ground surface, depending on the depth of acidic materials.

Scale In Feet
0 150
1"= 150'

NORTH

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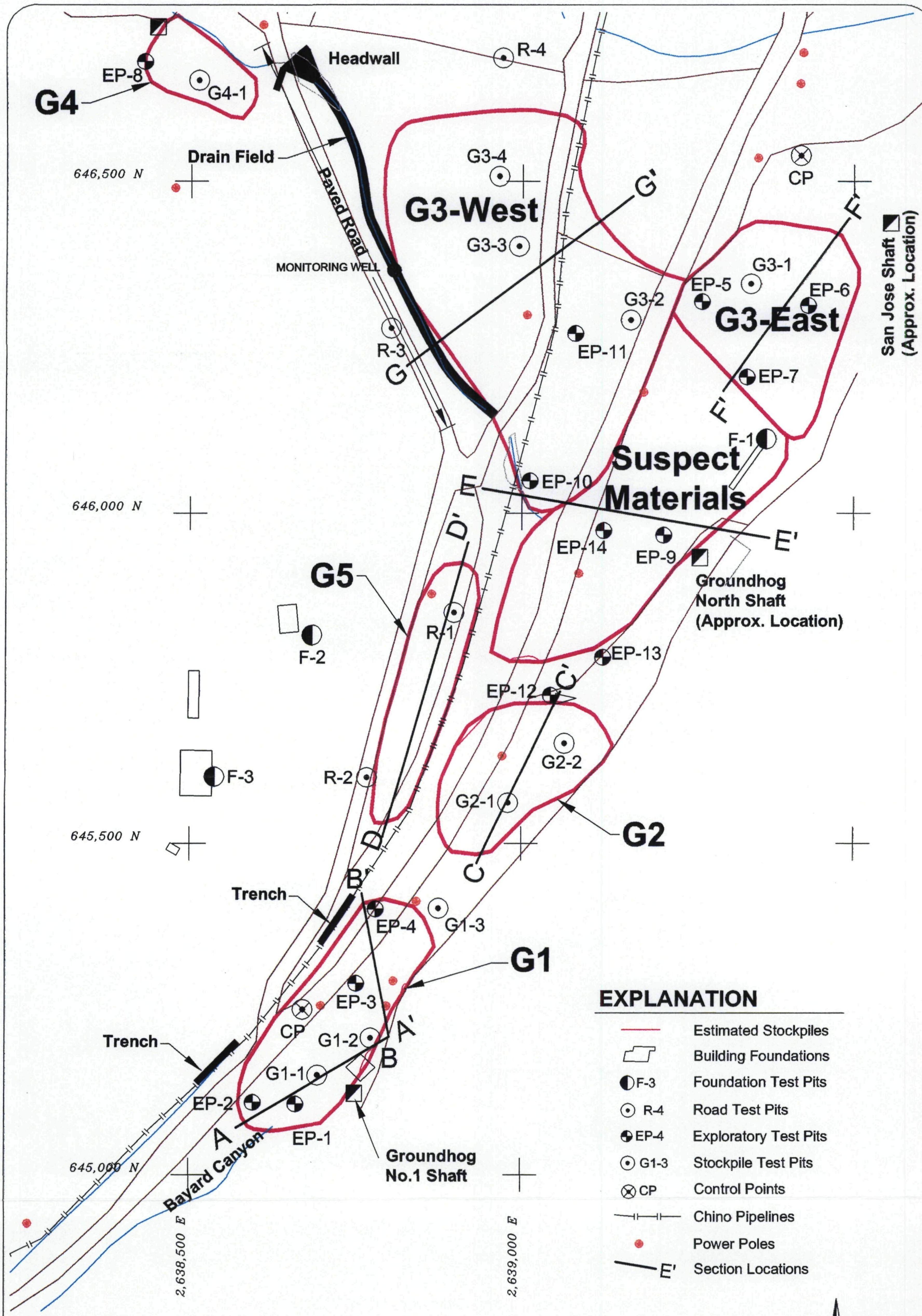
FIGURE 6
Existing & Bedrock Surfaces

PROJECT NO.	CLIENT	PROJECT	REVISION	DATE	SCALE
003-2562	Chino Mines Company	Groundhog Site Investigation	A	10/09/00	1"= 150'



NOTE

1. The surface beneath the stockpiles may represent either the bedrock or the depth to the original ground surface, depending on the depth of acidic materials.

Scale in Feet
0 150
1"= 150'

NORTH

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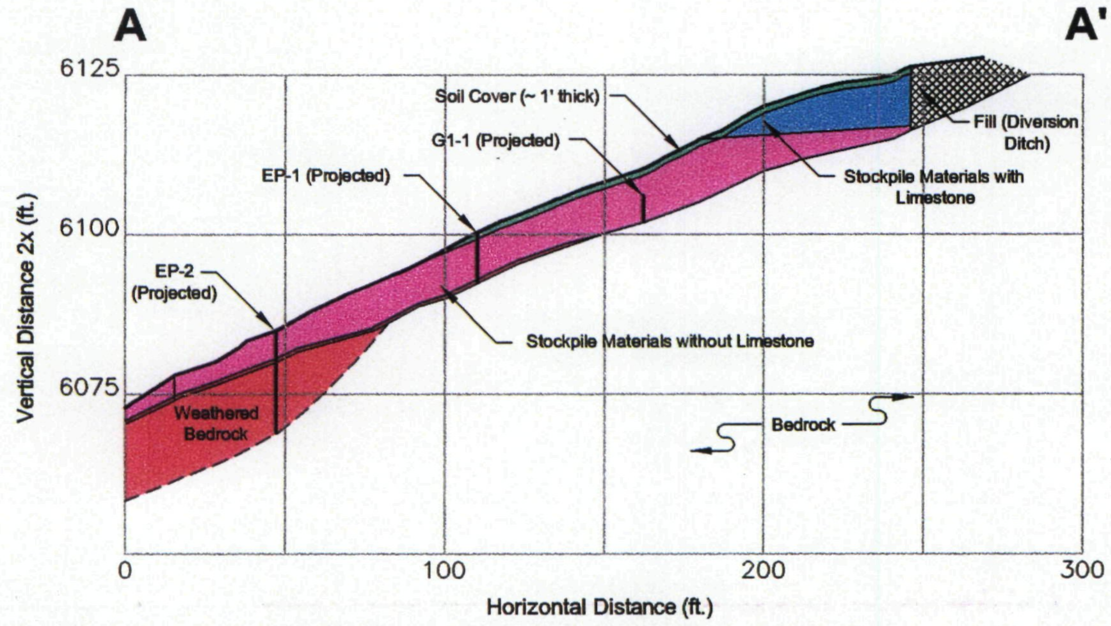
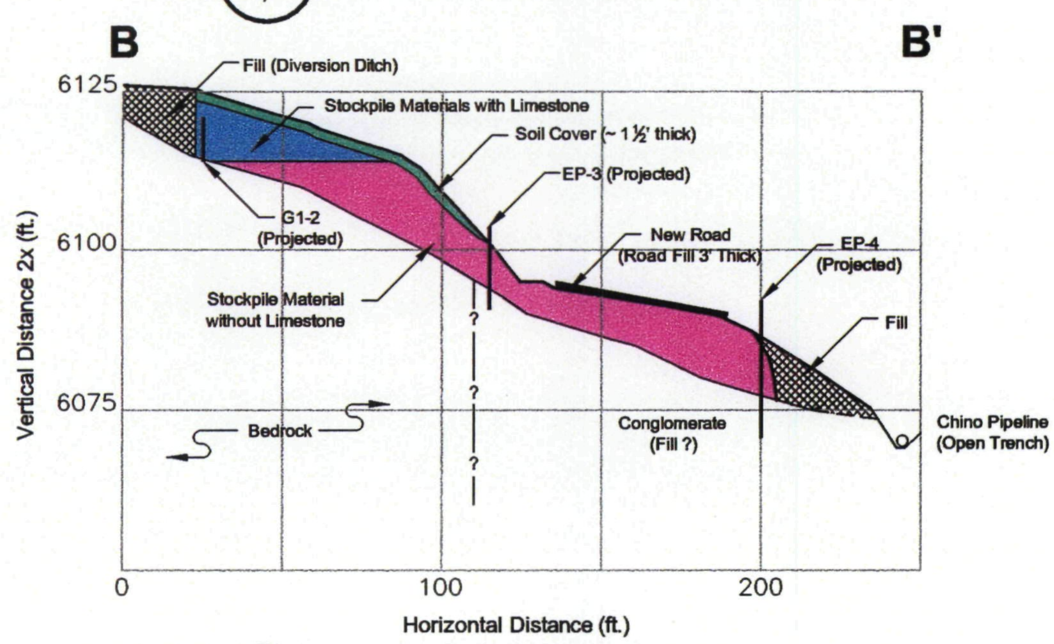
FIGURE 7
Delineation of Mine-Related Materials

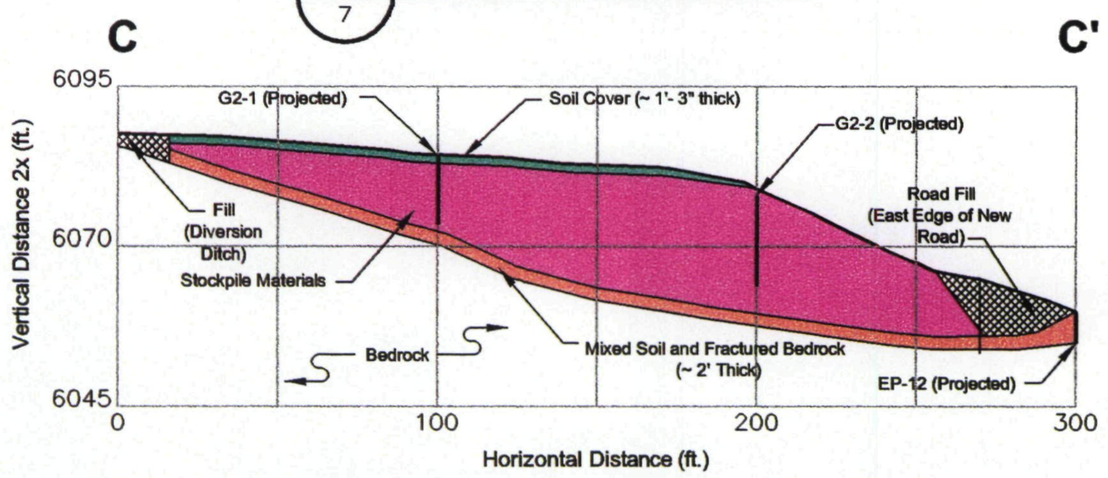
PROJECT NO.	CLIENT	PROJECT	REVISION	DATE	SCALE
003-2562	Chino Mines Company	Groundhog Site Investigation	A	10/09/00	1"= 150'



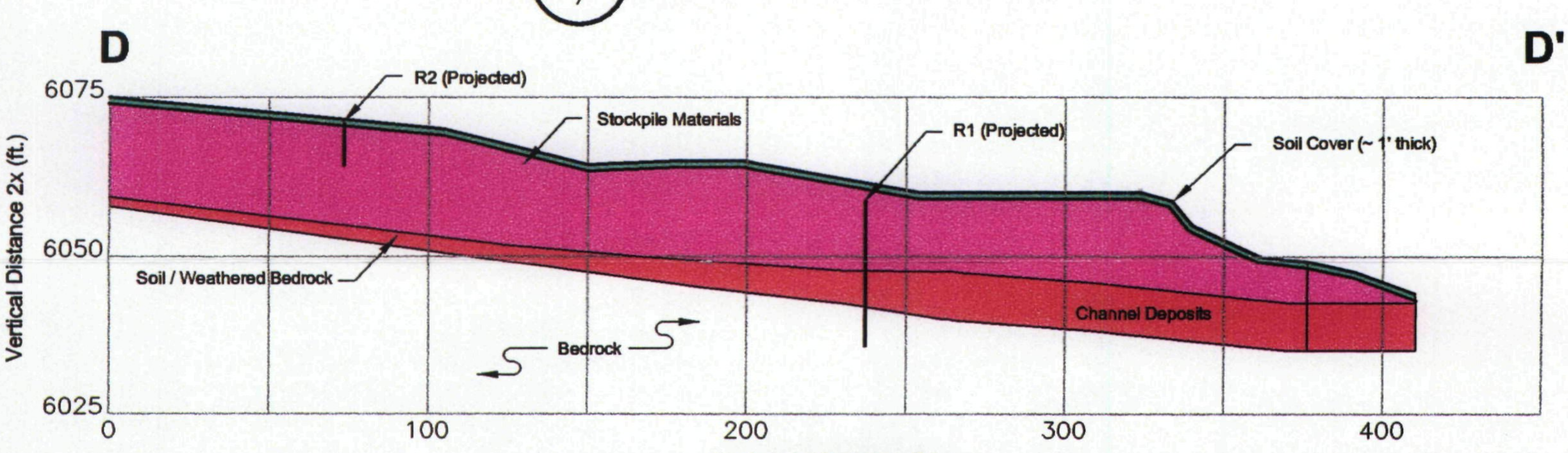
A 7 **G-1 CROSS SECTION A-A'**



B 7 **G-1 CROSS SECTION B-B'**



C 7 **G-2 CROSS SECTION C-C'**



D 7 **G-5 CROSS SECTION D-D'**

NOTES:

1. Contacts shown are based on aerial photographs, surface observations, and nearest test pits.
2. Test pits shown are projected on to the cross-section and therefore may not appear to extend to competent bedrock.

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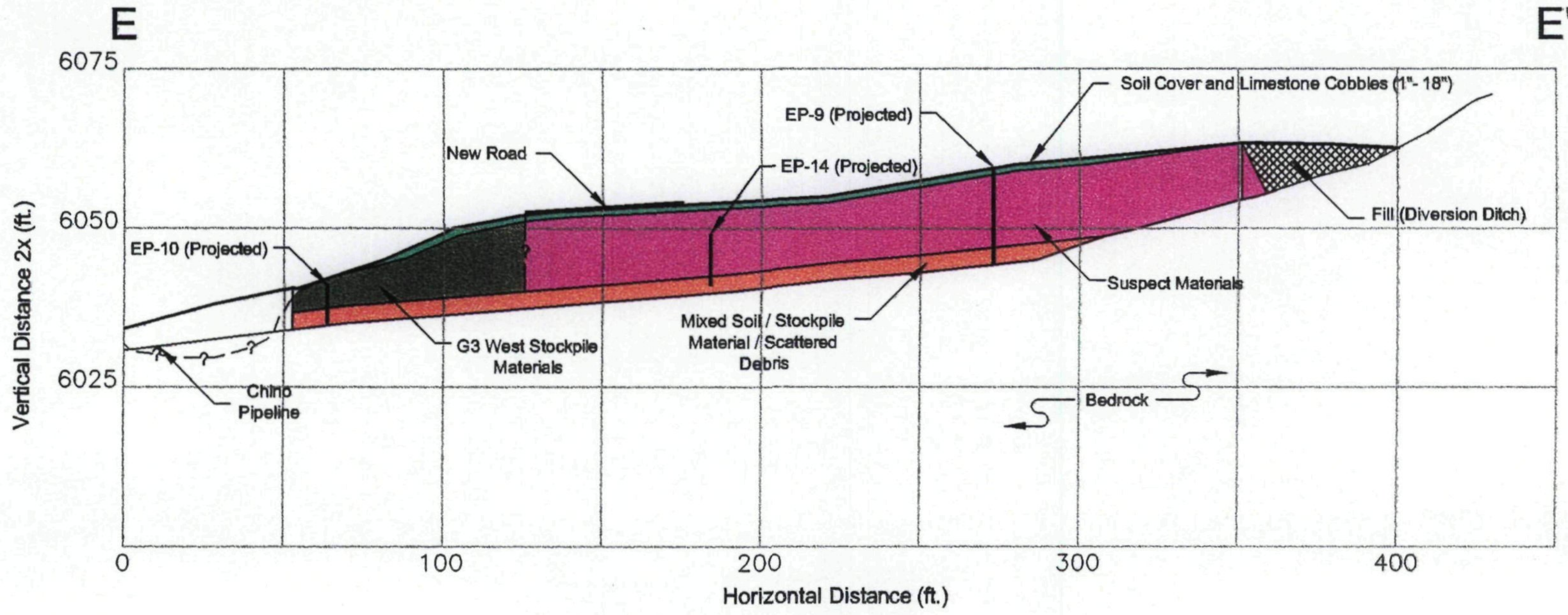
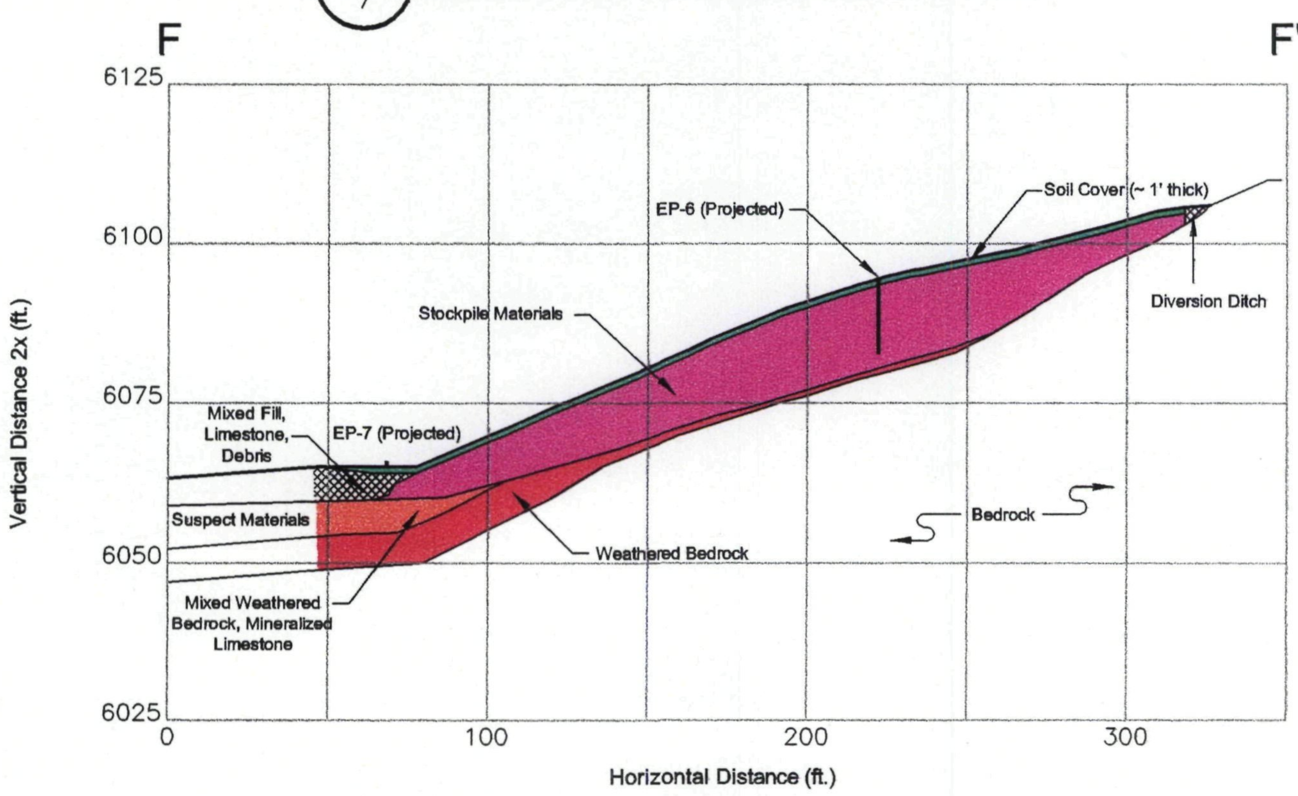
FIGURE 8

Cross-Sections Showing Volume Estimates

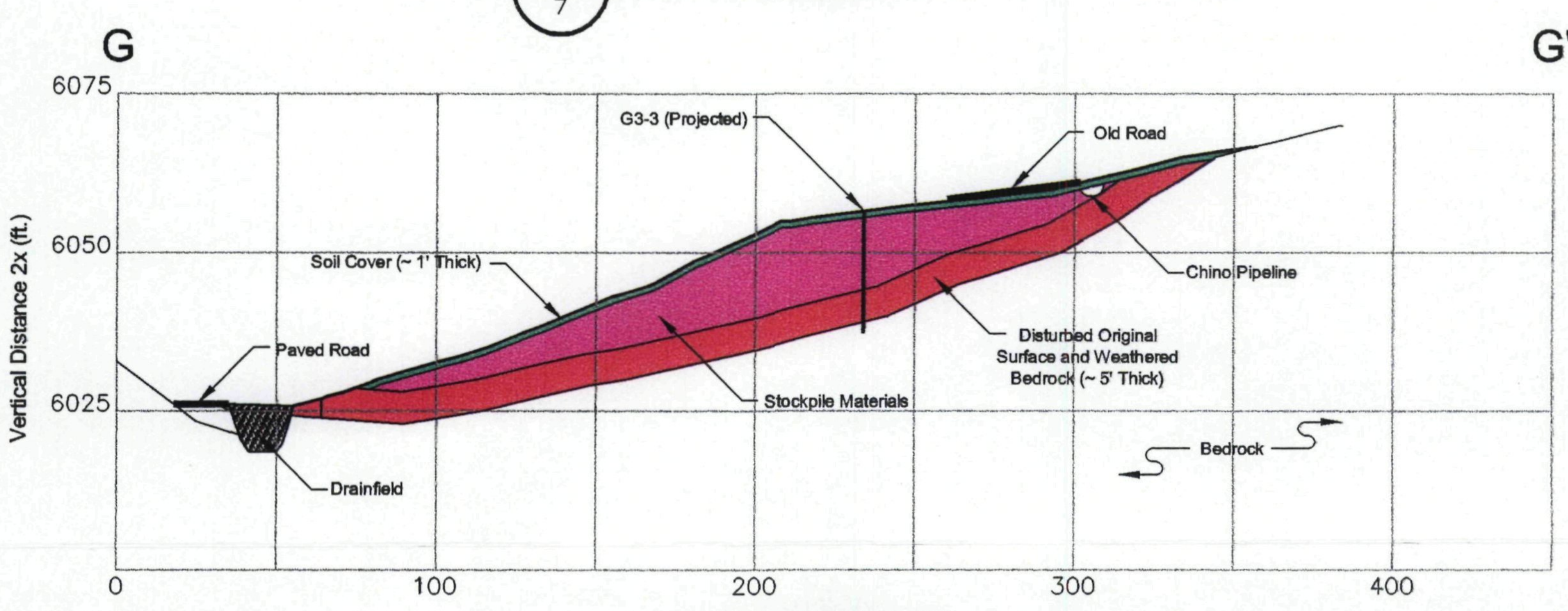
PROJECT NO.	CLIENT	PROJECT	REVISION	DATE	SCALE
003-2562	Chino Mines Company	Groundhog Site Investigation	A	10/09/00	1"= 60'



E 7 SUSPECT MATERIALS CROSS SECTION E-E'



F 7 G-3 CROSS SECTION F-F'



G 7 G-3 CROSS SECTION G-G'

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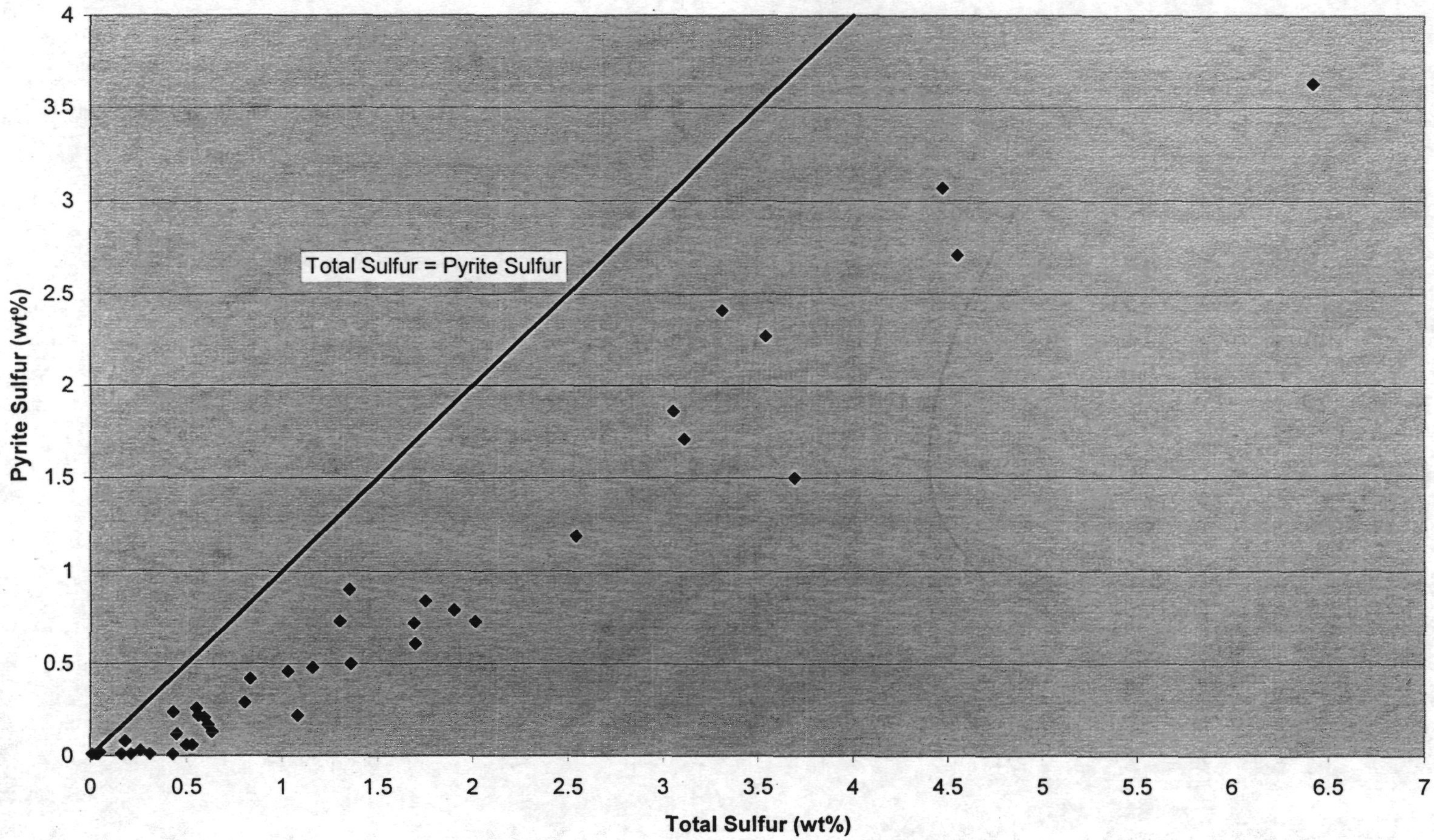
FIGURE 9

Cross-Sections Showing Volume Estimates

PROJECT NO.	CLIENT	PROJECT	REVISION	DATE	SCALE
003-2562	Chino Mines Company	Groundhog Site Investigation	A	10/09/00	1"= 60'



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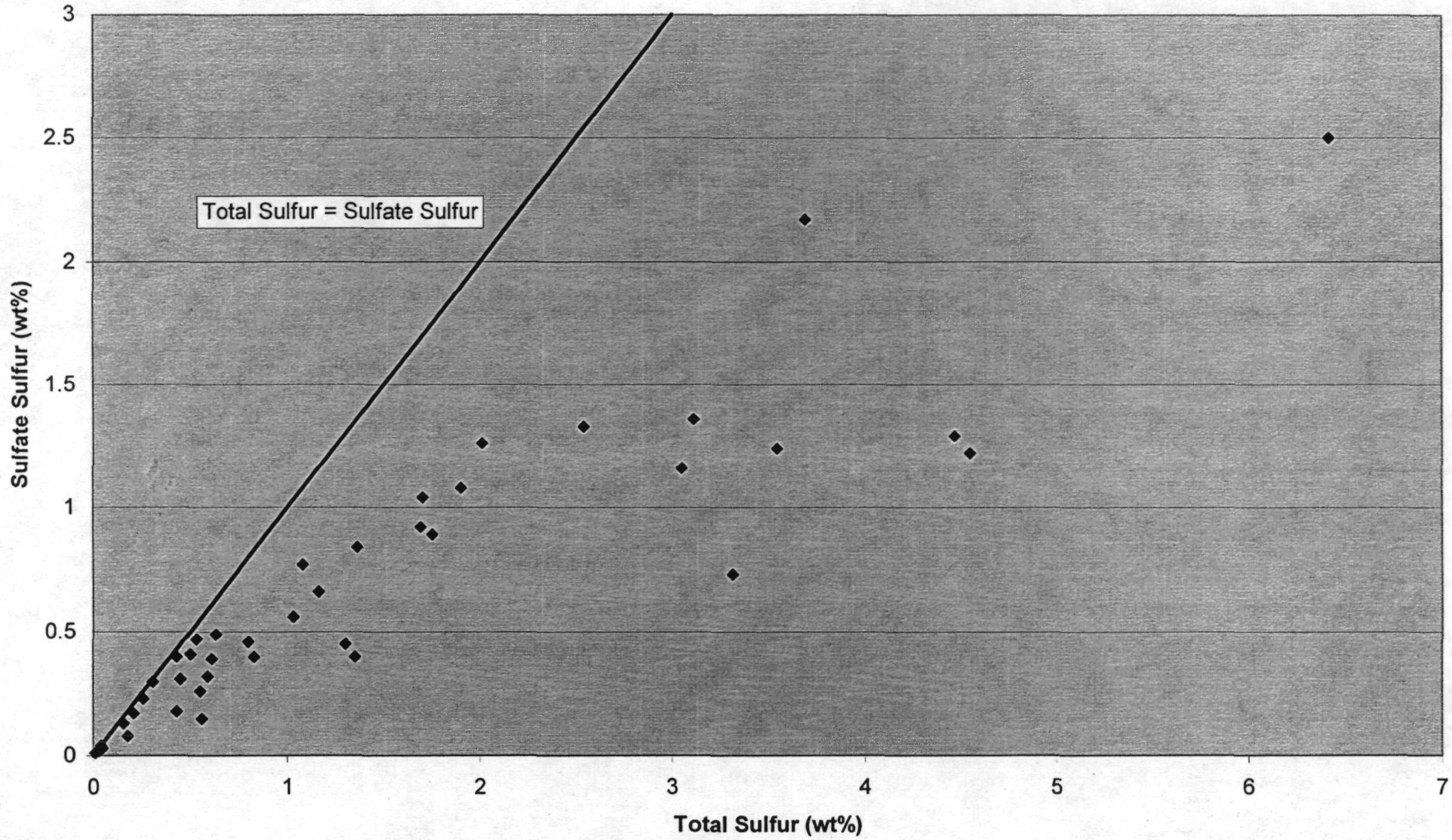
PROJECT NO.	DATE	REVISION
003-2562	10/09/00	A

FIGURE 10

Pyrite Sulfer Versus Total Surfur



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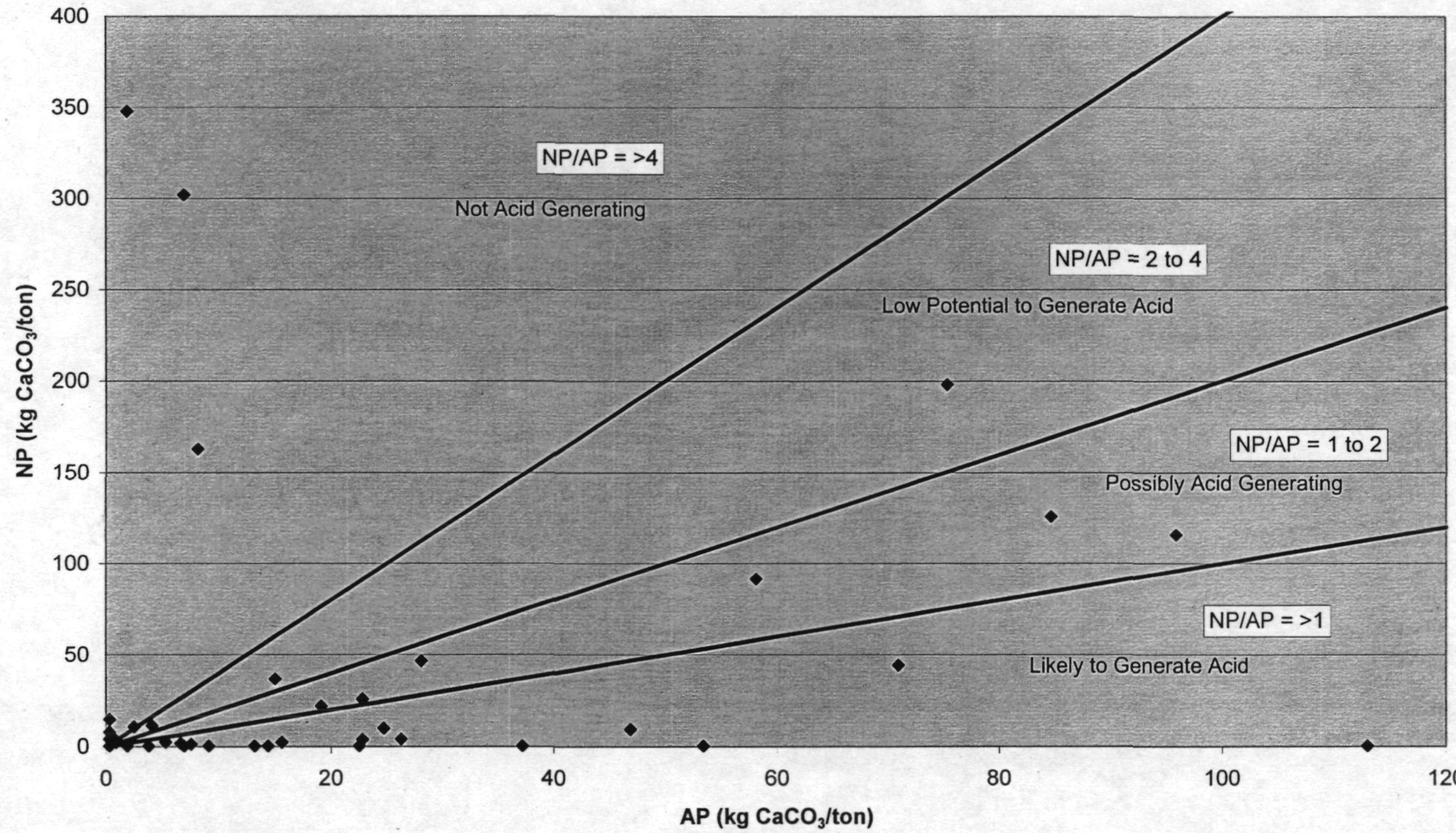
PROJECT NO.	DATE	REVISION
003-2562	10/09/00	A

FIGURE 11

Sulfate Sulfer Versus Total Surfur



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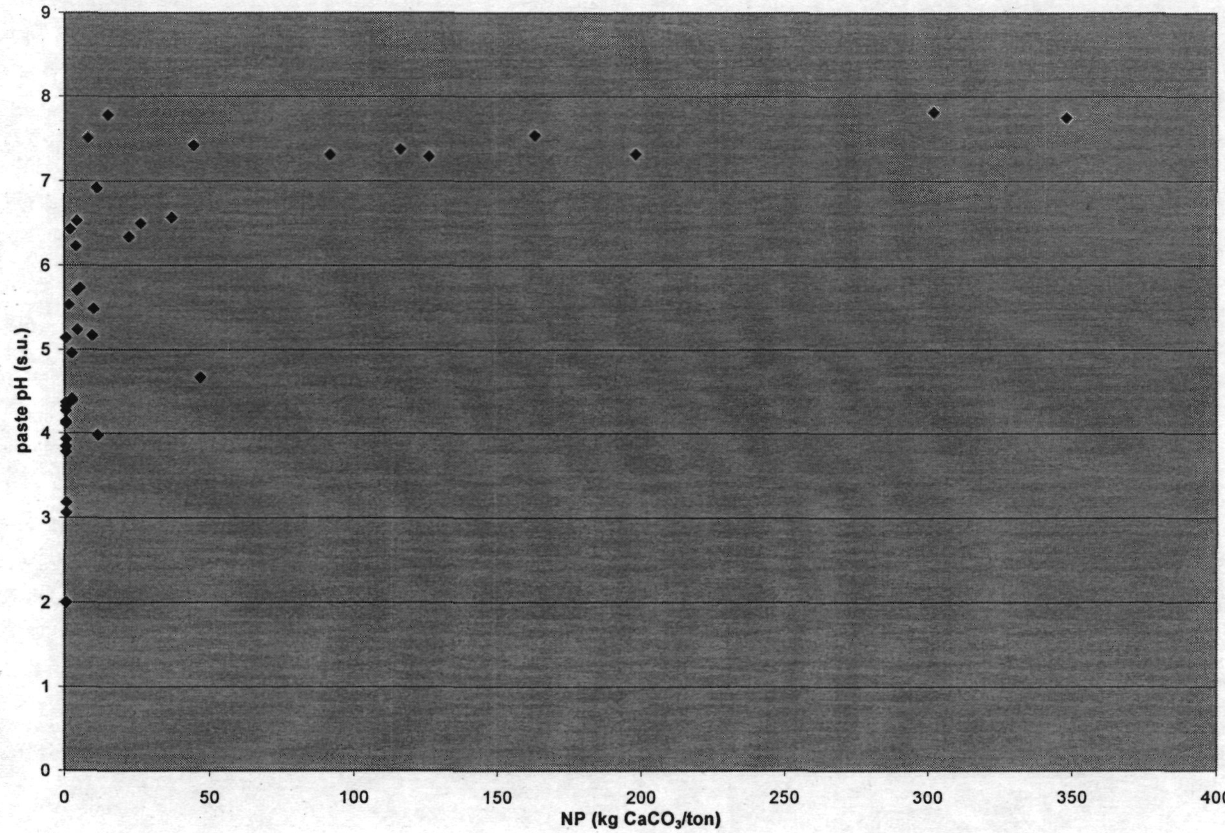
PROJECT NO.	DATE	REVISION
003-2562	10/09/00	A

FIGURE 12

Neutralization Potential Versus Acid Potential



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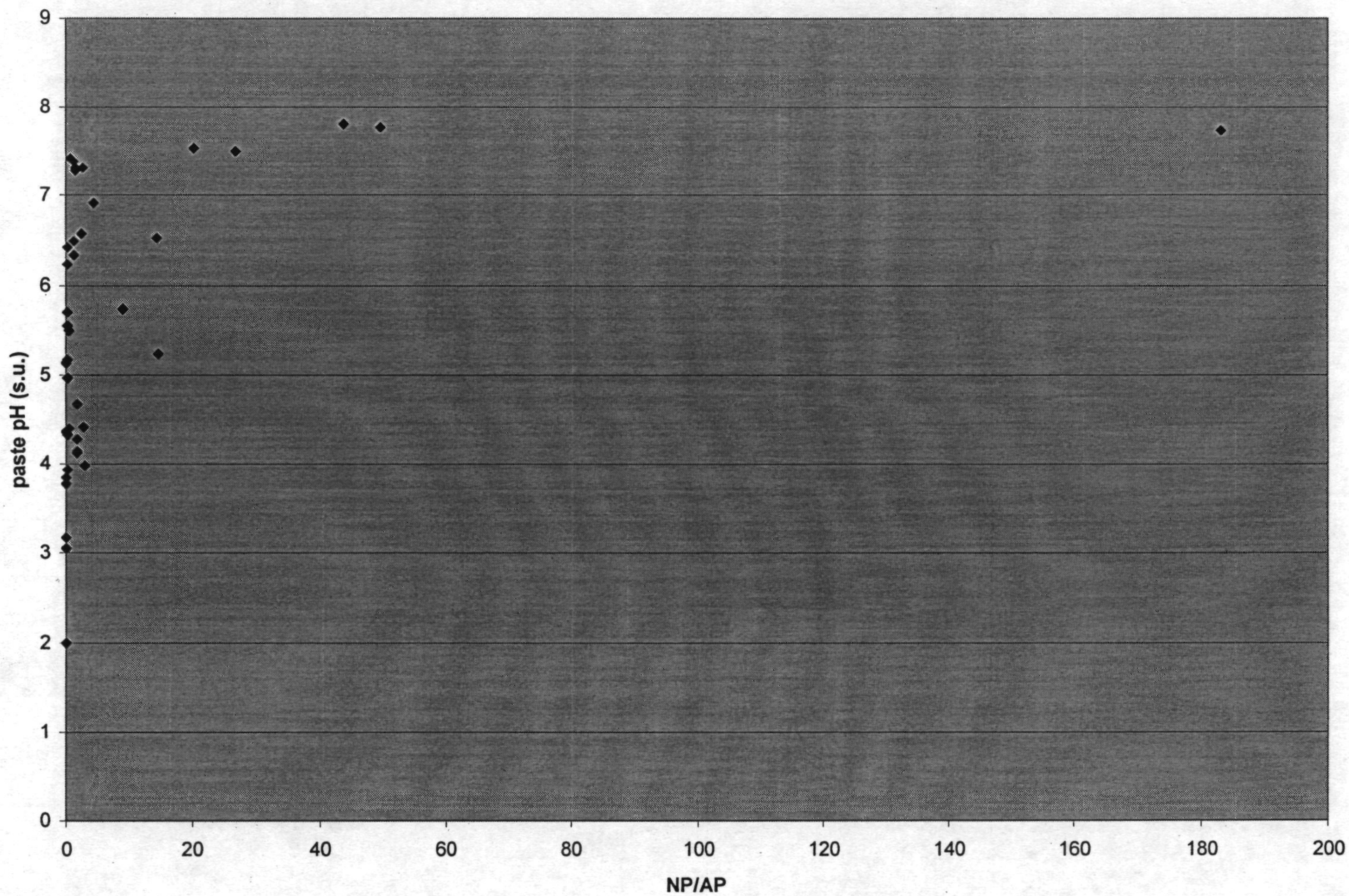
PROJECT NO.	DATE	REVISION
003-2562	10/09/00	A

FIGURE 13

Paste pH Versus NP

P:\\003-2562\2562T022_A.dwg



Golder Associates

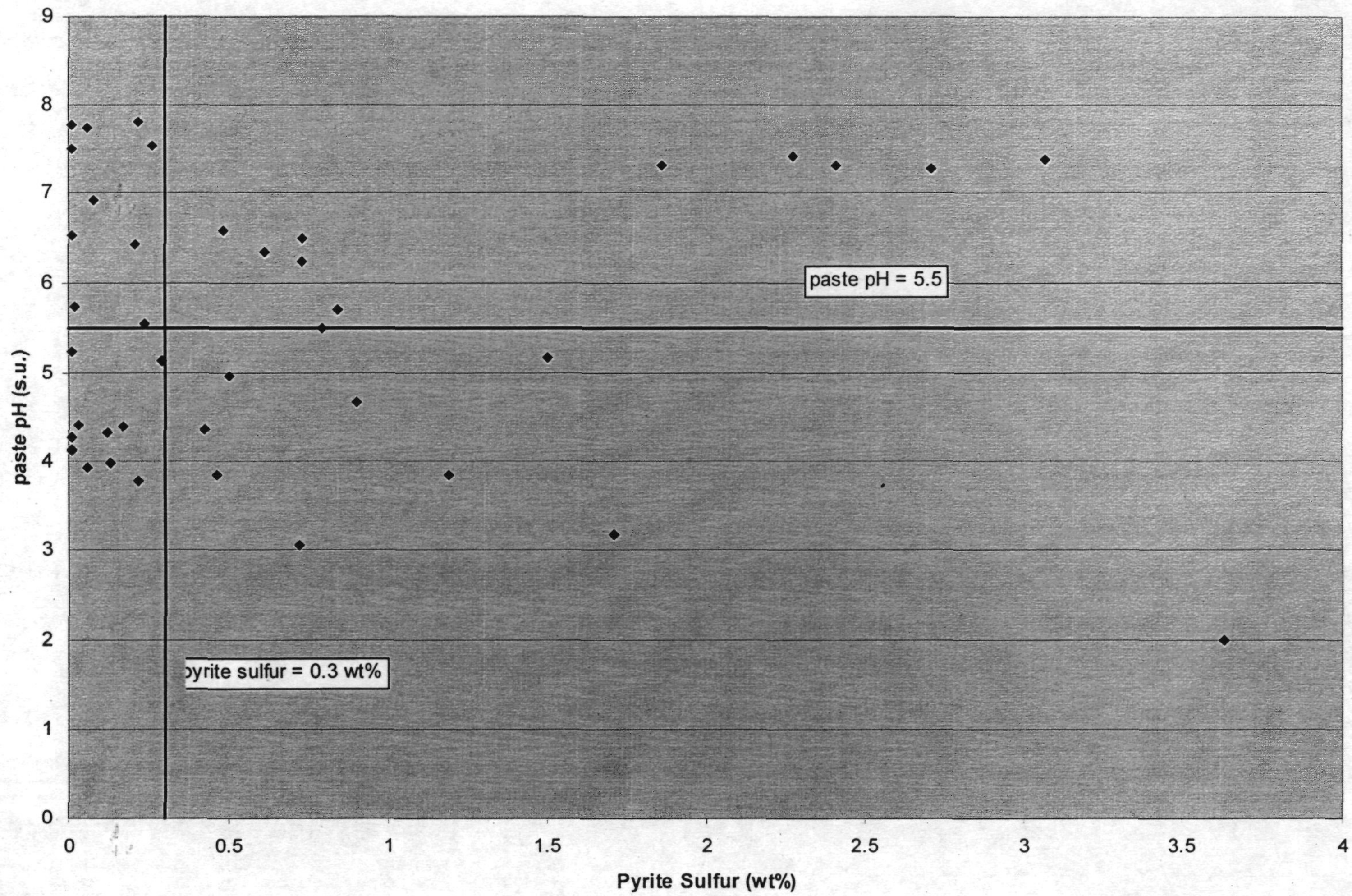
Tucson, Arizona

PROJECT NO.	DATE	REVISION
003-2562	10/09/00	A

FIGURE 14

Paste pH Versus NP/AP

P:\\003-2562\2562T023_A.dwg



P:\\003-2562\2562T024_A.dwg

Golder Associates

Tucson, Arizona

PROJECT NO.	DATE	REVISION
003-2562	10/09/00	A

FIGURE 15

Paste pH Versus Pyrite Sulfur

APPENDIX A

VEGETATION/SOIL COVER INVESTIGATION

Tetra Tech EM Inc.

SOIL AND VEGETATION CONDITIONS AT THE GROUNDHOG MINE RECLAMATION AREA

Prepared for:

Chino Mines Company
Hurley, New Mexico

Prepared by:

Tetra Tech EMI
6121 Indian School Road, Suite 205
Albuquerque, NM 87110

October 9, 2000

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TABLES

SOIL AND VEGETATION CONDITIONS AT THE GROUNDHOG MINE RECLAMATION AREA

Chino Mines Company

9 October 2000

1.0 INTRODUCTION

Tetra Tech EM Inc. conducted an investigation of the soils and vegetation on the reclaimed Groundhog mine site in Grant County, New Mexico (Figure 1, in Golder, 2000). The Groundhog mine area is within the Hanover/Whitewater Creeks Investigation Units. The investigation was conducted partially in response to the Conditional Approval Letter received by Chino Mines Company (Chino) from the New Mexico Environment Department (NMED) on January 27, 2000.

The Groundhog stockpiles were covered and seeded in 1992 and 1993 by the previous owner. In 1994, additional activities were conducted in some areas to reclaim materials moved from the Denver and Lucky Bill shaft areas. Reconnaissance of the Groundhog site indicates that the majority of the area with intact soil covers is well vegetated. The Administrative Order on Consent (AOC) Community Work Group requested that the vegetation and underlying soils be characterized to support the development of voluntary remedial options for the area. The primary objectives of the investigation were to determine the vegetation cover levels and chemical and physical characteristics of the underlying soil materials. This investigation is expected to aid in the resolution of issues concerning adequate soil cover thickness for the development of a self-sustaining ecosystem.

This study was conducted concurrently with a detailed investigation of the Groundhog Mine by Golder Associates (Golder, 2000). The investigation of the soil and vegetation condition is included as an attachment to the Golder report and the figures referred to herein can be found in the in the Golder report.

2.0 METHODS

The methods used in the vegetation characterization are described in section 2.1. The field and laboratory methods used in the soils investigation are described in sections 2.1 and 2.2, respectively.

2.1 FIELD METHODS

Vegetation and soil sampling plots were selected in areas with uniform vegetation cover that were representative of the reclaimed stockpile area. The vegetation plots were located in collaboration with representatives of the NMED and Mining and Minerals Division (MMD). Three 100-m^2 vegetation plots were selected that are approximately equivalent with respect to important landscape attributes (e.g., aspect, slope gradient, and topographic position). The vegetation within each 100-m^2 plot was characterized by measuring vegetation and surface cover attributes from ten 0.25-m^2 quadrats. The quadrats were located after establishing a 0.25-m^2 grid and using a list of random numbers.

Ocular estimates of total canopy cover, species canopy cover, basal cover, surface litter, rock, and bare soil were made in each quadrat. Professional botanists (Clara Bambauer and Jacob Worley) characterized the vegetation during the spring and summer of 2000. Percent-area cards were used to increase accuracy of the cover estimates. Canopy cover estimates were made by species for plants rooted within the quadrat. In this study, canopy cover is defined as the percentage of quadrat area included in the vertical projection of the canopy (Daubenmire, 1968). The canopy cover estimate includes foliage and foliage interspaces of all individuals rooted in the quadrat. The canopy cover estimates made on a species basis may exceed 100 percent in individual quadrats where the vegetation has multi-layered canopies. In contrast, the sum of the total canopy cover, surface litter, rock fragments, and bare soil will not exceed 100 percent.

Basal cover is defined as the proportion of the ground surface occupied by the crowns of grasses and rooting stems of forbs and shrubs. Basal cover estimates were made for vegetation, surface litter, rock fragments, and bare soil. Like total cover estimates, the basal cover estimates will not exceed 100 percent.

Soil samples were collected from three randomly located, hand-excavated pits within each vegetation plot. The soils were sampled by layer to a total depth of 12 inches below the imported cover soil. The soils were described and sampled by a certified professional soil scientist (Dr. Lewis Munk). Distinct layers more than four inches thick were sampled separately. Soil color and effervescence were described in the field using standard methods (Soil Survey Division Staff, 1993). The soil samples were placed directly in gallon-size plastic bags and shipped to the analytical laboratory in ice chests at ambient temperature.

2.2 LABORATORY METHODS

The testing requirements for this investigation were developed in consultation with the MMD and analyses were conducted using methods that correspond to those specified in the Closeout Plan Guidelines (MMD, 1996). The samples were air-dried and passed through a 2 mm sieve with minimal crushing of the rock fragments. The chemical analyses were conducted on the soil fine-earth fraction (< 2-mm particles) according to the methods specified in Table 1.

Table 1. Analytical methods used in the Groundhog soil characterization.

Analysis	Source-Method
Paste Ph	Agron. 9; Part 2 Method 10-3.1
Electrical Conductivity	Agron. 9; Part 2 Method 10-3.3
Saturation Percentage	USDA Handbook 60- Method 2, 3a, 27a, and 27b
Ca, Mg, Al, Cd, Cu, Mo, Ni, Mn, Pb	Paste extraction- ICP and ICP-Mass Spec.
$CaCO_3$ Equivalent Percent	USDA Handbook 60 - Batch acid/base titration
ABA and Sulfur Forms	Sobek et al., 1978. Resistance furnace
Neutralization Potential	Sobek et al., 1978. Batch acid/base titration
Nitrate	Agron. 9; Part 2 Method 10-2.3.2
Phosphorous	Agron. 9; Part 2 Method 24-5.4
Organic Carbon Percent	Loss on ignition (400°C)
USDA Texture (sand, silt, clay)	Agron. 9: Part 1, Method 43-5. (Hydrometer)

Agron. 9 Methods of soil analysis. Part 2, 2nd ed. Soil Science Society of America.
USDA Handbook 60 = Richards (1954)

3.0 RESULTS

Results of the field and laboratory studies are described in the sections 3.1 (vegetation) and 3.2 (soils).

3.1 VEGETATION

A site-wide vegetation survey of the Groundhog property conducted in February 2000 revealed a variety of grasses (22 species), forbs (32 species), and shrubs, trees, and cactus (9 species) growing on the reclaimed areas. The plants identified during the February, 2000 survey are listed in Tables 2, 3, and 4.

Table 2. Shrubs, trees, and cacti identified on the Groundhog reclamation site

Common Name	Scientific Name
Tarragon	*Artemesia dracunculus*
California bricklebush	*Brickellia californica*
Broom snakeweed	*Gutierezia sarothrae*
Alligator juniper	*Juniperus deppeana*
Tree cholla	*Opuntia imbricata*
Fremont's cottonwood	*Populus fremontii*
Honey mesquite	*Prosopis glandulosa*
Emory oak	*Quercus emoryii*
Soaptree yucca	*Yucca elata*

Table 3. Grasses identified on the Groundhog reclamation site

Common Name	Scientific Name
Six weeks threeawn	*Aristida adscensionis*
Poverty threeawn	*Aristida divaricata*
Single threeawn	*Aristida orcuttiana*
Purple threeawn	*Aristida purpurea*
Six weeks grama	*Bouteloa barbata*
Cane bluestem	*Bothriochloa barbinodis*
Black grama	*Bouteloua eriopoda*
Yellow bluestem	*Bothriochloa ischaeum*
Sideoats grama	*Bouteloua curtipendula*
Blue grama	*Bouteloua gracilis*
Hairy grama	*Bouteloua hirsuta*
Feather fingergrass	*Chloris virgata*
Weeping lovegrass	*Eragrostis curvula*
Stinkgrass	*Eragrostis cilianensis*
Low woollygrass	*Erioneuron pulchellum*
Curleymesquite	*Hilaria belangeri*
Hall's panicum	*Panicum hallii*
Streambed bristlegrass	*Setaria leucopila*
Sand dropseed	*Sporobolus cryptandrus*
Mesa dropseed	*Sporobolus flexuosus*
Bottlebrush squirreltail	*Sitanion hystrix*

Table 4. Forbs identified on the Groundhog reclamation site.

Common Name	Scientific Name
Wooly milkvetch	*Astragalus mollissimus*
Dwarf stickpea	*Calliandra humilus*
Thymeleaf sandmat	*Chamaesyce serpyllifolia*
Sonoran prairie clover	*Dalea filiformis*
Cooley's bundleflower	*Desmanthus cooleyi*
Rose's ticktrefoil	*Desmodium rosei*
Abert's eriogonum	*Eriogonum abertianum*
Red dome blanketflower	*Gaillardia pinnatifida*
Slender goldenweed	*Haplopappus gracilis*
Annual sunflower	*Helianthus annuus*
Showy goldeneye	*Heliomeris multiflora*
Wingpetal	*Heterospermum pinnatum*
Wrights thimblehead	*Hymenothrix wrightii*
Transpecos morning-glory	*Ipomoea cristulata*
Manyflowered gilia	*Ipomopsis multiflora*
Morning-glory	*Ipomoea sp.*
Tanseyleaf aster	*Machaeranthera tanacetifolia*
Horehound	*Marrubium vulgare*
Dwarf mentzelia	*Mentzelia pumila*
Rough menodora	*Menodora scabra*
Beardlip penstemon	*Penstemon barbatus*
Fivebract cinchweed	*Pectis filipes*
Pigweed	PHYSALIS sp.
Coneflower	*Ratibida tagetes*
Russian thistle	*Salsola iberica*
Sage	SALVIA sp.
Douglas' groundsel	*Senecio douglasii*
Silverleaf nightshade	*Solanum eleagnifolium*
Scarlet globemallow	*Sphaeralcea coccinea*
Tarragon	*Artemesia dracunculus*
California bricklebush	*Brickellia californica*
Broom snakeweed	*Gutierezia sarothrae*
Alligator juniper	*Juniperus deppeana*
Tree cholla	*Opuntia imbricata*
Fremont's cottonwood	*Populus fremontii*
Honey mesquite	*Prosopis glandulosa*
Emory oak	*Quercus emoryii*
Soaptree yucca	*Yucca elata*

Vegetation and ground cover data were collected in the three 100-m^2 vegetation plots shown on Figure 2 (Golder, 2000). The vegetation data were collected in June of this year prior to the onset of the growing season when the canopies of the annual plants were not fully developed. Table 5 is statistical summary of the canopy and basal cover data from the plots.

Table 5. Mean vegetation and ground cover attributes in the Groundhog vegetation plots.

Type	Vegetation	Rock	Litter	Bare Soil	Grass	Forbs	Shrubs
	(Mean Cover %)				(Relative Cover %)		
Canopy	24.7	48.9	2.4	24.0	24.6	T	T
Basal	10.5	57.4	3.2	28.9	10.3	T	T

T = less than 0.05 percent

The cover data from the Groundhog vegetation plots compare favorably to the reference area data collected from Chino's Rustler Canyon reference area in 1999. The reference area data provide a snapshot of the vegetation conditions at the end of the 1999 growing season. The total canopy cover in the reference area was about 45 percent with nearly half of the total canopy cover contributed by annual forbs and grasses (DBS&A, 1999). Thus, the total canopy cover on the Groundhog vegetation plots is about 55 percent of the total cover on the Rustler Canyon reference area with almost all the cover contributed by perennial grasses. This total cover value is somewhat lower than the proportional guideline for revegetation success (i.e., 70 percent of the reference area cover) proposed by Chino (DBS&A, 1999). However, the direct comparison of total canopy cover at the Groundhog site and Rustler Canyon reference area is complicated by differences in plant composition.

Annual plants contributed significantly to the canopy cover at Rustler Canyon reference area, but were generally lacking at the Groundhog site. It is important to recognize the contribution of the annual plants because their cover and frequency vary significantly with the prevailing weather conditions compared to perennial plants. Annual plants are expected to occur at lower frequencies and contribute less cover in years with lower summer precipitation. For this reason, annual plants are not considered stable components of the reclaimed ecosystem from an erosion control perspective, even though they may provide value in other aspects.

Basal cover of perennial plants provides a more consistent basis of comparison than canopy cover because it is less affected by climatic variables and animal use (livestock of wildlife). The vegetation basal cover at the Groundhog site (10 percent) was more than four times higher than the Rustler Canyon reference area

(2.4 percent) reflecting the growth form of perennial grasses relative to annual grasses and forbs. The relatively high vegetation basal cover at the Groundhog site is interpreted to indicate that the revegetation is progressing well in the vegetation test plots. The total canopy cover data probably do not fairly represent the status of the reclaimed areas relative to the reference area because of compositional differences. Nonetheless based on the basal cover data, the reclamation can be considered more successful than is implied by the simple comparison of the total canopy cover data to reference area.

3.2 SOIL INVESTIGATION

This section describes the results of the soil investigation in the vegetation test plots at the Groundhog mine reclamation area. Section 3.2.1 includes observations of the soil test pits made in the field. Section 3.2.2 contains the laboratory data and interpretation of the results.

3.2.1 Field Observations

Abbreviated field descriptions of the soils and underlying wastes are listed in Table 6. The imported cover soils ranged in thickness from about 1 to 10 inches. The soils and underlying waste materials contained moderate to high volumes of rock fragments and most of the underlying waste materials contained limestone and/or dolomite rock fragments. The cover soils were non-effervescent indicating that they lacked free calcium carbonate, whereas the underlying materials generally reacted with weak hydrochloric acid. Roots were observed in all the test pits with the majority of the roots concentrated in the upper part of the soils. The distribution of roots is consistent with regional climatic regime and kinds of vegetation that occupy the site.

Table 6. Abbreviated description of the surface soils in the Groundhog reclamation area.

Site	Depth (inches)	Material	Munsell Color (moist)	Effer-vescence	Rock Fragments Volume (%)	Roots
NVA-1	0-5	Cover soil	7.5YR 4/3	eo	45	Common, very fine
NVA-1	5-17	Waste rock	10YR 5/4	eo	45	Few, very fine to 14"
NVA-2	1-13	Waste rock	10YR 5/4	eo	45	Few, very fine
NVA-3	0-7	Cover soil	7.5YR 5/4	eo	5	Common, very fine
NVA-3	5-19	Waste Rock	10YR 6/6	eo	65	Few, very fine to 15"
MVA-1	0-5	Cover soil	7.5YR 5/4	eo	30	Common, very fine
MVA-1	5-17	Waste Rock	10YR 6/4	es	65	Few, very fine to 16"
MVA-2	0-5	Cover soil	7.5YR 5/4	eo	15	Common, very fine
MVA-2	5-17	Waste Rock	10YR 6/4	es	65	Few, very fine to 14"
MVA-3	0-7	Cover soil	7.5YR 5/4	eo	20	Common, very fine
MVA-3	7-19	Waste Rock	10YR 6/4	e	65	Few, very fine to 19"
SVA-1	0-8	Cover soil	7.5YR 3/4	eo	20	Common, very fine
SVA-1	8-20	Waste Rock	10YR 6/3	e	75	Few, very fine to 17"
SVA-2	0-7	Cover soil	7.5YR 3/4	eo	20	Common, very fine
SVA-2	7-19	Waste Rock	10YR 6/4	e	65	Few, very fine to 20"
SVA-3	0-10	Cover soil	7.5YR 3/4	eo	20	Common, very fine
SVA-3	10-22	Waste Rock	10YR 6/4	e	65	Few, very fine to 20"

eo = non-effervescent; e = effervescent; es = strongly effervescent (Soil Survey Division Staff, 1993)

3.2.2 Soil Chemical and Physical Characteristics

The chemical and physical attributes of the cover soils and waste materials in the vegetation plots are listed in Tables 7. The fine-earth fractions of these materials are moderately coarse- to medium-textured, nonsaline, and have moderate water contents at saturation. The materials range from circum-neutral to slightly acid and have low levels of available nitrogen and phosphorus. The organic carbon contents are incongruously high compared to the color of the soil materials based on standard relationships (soil Survey Division Staff, 1996). The organic carbon data probably represent artifacts of mineral dehydration (e.g., gypsum and Fe- and Al-oxyhydroxide and metal-sulfates) rather than the combustion and loss of soil organic matter. Thus, the weight loss from heating probably is associated with the loss of water from $CaSO_4$-$2H_2O$ (gypsum) rather than the combustion of organic compounds. The primary limitation associated with these materials from an immediate perspective is the moderately high rock fragment content.

Table 7. Soil chemical and physical attributes in the Groundhog vegetation plots

Sample	pH	EC (dS/m)	Saturation Percentage (% H_2O)	Nitrate as N (mg/kg)	Phosphorus (mg/kg)	Organic Carbon (%)	Lime (%)	S (%)	Si (%)	C (%)	USDA Texture (Class)	Rock Fragments (Mass %)
South Vegetation Plot												
SVA-1	7.2	2.16	41.1	0.6	4.6	3.4	2.1	50	23	27	SCL	24
SVA-1	7.4	2.52	29.3	0.3	1.1	2.5	15.6	60	29	11	SL	57
SVA-2	7.4	2.35	41.1	0.7	3.9	2.9	2.3	49	23	28	SCL	31
SVA-2	7.2	2.42	30.6	0.3	1.5	2.7	11.3	58	31	11	SL	57
SVA-3	7.3	2.33	39.5	0.3	4.4	2.8	1.7	48	24	28	SCL	28
SVA-3	7.4	2.45	30.0	0.3	1.6	2.7	16.3	58	27	15	SL	50
Middle Vegetation Plot												
MVA-1	7.5	2.24	32.4	1.2	7.2	2.5	3.2	56	21	23	SCL	64
MVA-1	7.4	2.70	32.9	0.4	1.8	2.7	5.0	54	35	11	SL	48
MVA-2	7.4	1.97	38.6	0.4	4.3	2.4	1.4	49	23	28	SCL	47
MVA-2	7.3	2.52	30.9	0.3	1.0	2.7	5.6	54	39	7	SL	53
MVA-3	7.6	1.65	39.5	0.3	4.3	2.5	3.1	47	26	27	SCL	34
MVA-3	7.4	2.60	29.4	0.2	1.0	2.1	10.5	58	33	9	SL	48
North Vegetation Plot												
NVA-1	7.5	1.30	28.8	0.3	4.3	2.0	1.4	52	24	24	SCL	52
NVA-1	7.0	2.20	33.9	0.2	2.3	2.9	3.5	52	30	18	L	52
NVA-2	6.4	2.53	33.9	0.4	1.3	3.1	3.1	55	34	11	SL	54
NVA-3	7.6	0.82	47.2	0.2	2.2	2.9	2.6	42	25	33	CL	29
NVA-3	6.3	2.35	32.7	0.2	<1	3.4	3.0	54	38	8	SL	52

EC = Electrical conductivity; S = sand; Si = silt; C = clay; SCL = sandy clay loam; SL = sandy loam; CL = clay loam; L = loam

The extraction of chemical constituents at the saturation percentage represents the soil water state closest to field conditions and that still provides a enough solution for laboratory analysis. The saturation extract metal concentrations from the cover soil and waste rock are listed in Table 8. The extractable metal concentrations are all below the limits in the MMD guidelines with the exception of two samples from the north vegetation plots that have slightly elevated levels of cadmium (Cd). The ratio of calcium to magnesium is generally favorable in all the materials. The relatively low metal concentrations in solution are consistent with the circum-neutral pH's and free calcium carbonate in the waste materials and soils.

Table 8. Extractable element concentration from soils in the Groundhog vegetation plots.

Sample	Depth (inches)	Ca	Mg	Al	Cu	Cd (mg/l)	Mn	Mo	Ni	Pb
South Vegetation Plot										
SVA-1	0-8	582	93	0.4	<0.1	<0.05	0.08	<0.1	<0.1	<0.1
SVA-1	8-20	625	150	0.3	<0.1	0.09	0.22	<0.1	<0.1	<0.1
SVA-2	0-7	680	99	<0.2	<0.1	<0.05	<0.05	<0.1	<0.1	<0.1
SVA-2	7-19	664	120	1.0	<0.1	0.09	0.34	<0.1	<0.1	<0.1
SVA-3	0-10	672	100	0.6	<0.1	<0.05	0.08	<0.1	<0.1	<0.1
SVA-3	10-22	626	130	0.3	<0.1	0.07	0.17	<0.1	<0.1	<0.1
Middle Vegetation Plot										
MVA-1	0-5	605	83	0.3	<0.1	<0.05	<0.05	<0.1	<0.1	<0.1
MVA-1	5-17	570	231	0.9	<0.1	0.07	0.17	<0.1	0.2	<0.1
MVA-2	0-5	513	87	0.3	<0.05	<0.01	0.03	<0.05	<0.05	<0.05
MVA-2	5-17	643	156	<0.2	<0.1	0.10	0.29	<0.1	<0.1	<0.1
MVA-3	0-7	424	54	0.2	<0.05	<0.01	0.02	<0.05	<0.05	<0.05
MVA-3	7-19	601	197	0.8	<0.1	0.08	0.29	<0.1	<0.1	<0.1
North Vegetation Plot										
NVA-1	0-5	355	34	0.8	<0.05	<0.01	0.03	<0.05	<0.05	<0.05
NVA-1	5-17	655	83	0.8	<0.1	0.09	0.18	<0.1	0.1	<0.1
NVA-2	1-13	638	140	0.5	<0.1	0.29	4.18	<0.1	<0.1	<0.1
NVA-3	0-7	158	42	<0.1	0.1	<0.01	0.02	<0.05	<0.05	<0.05
NVA-3	7-19	711	70	0.2	<0.1	0.42	7.66	<0.1	0.1	<0.1

Acid base account and sulfur form data for the cover soil and underlying waste rock are presented in Table 9. The cover soils have positive ABA's and are not expected to form excess acidity as they weather. Some, but not all of the waste rock samples had ABA's below the MMD suitability guideline of –5 T/kT (MMD, 1996). The pH's of the samples with the lowest ABA's are slightly acid but still within the acceptable range of the MMD suitability guidelines. The ABA test method used in this study tends to over-predict the acid generating potential of samples that contain non-acid producing sulfide minerals like chalcocite (Cu_2S) and galena (PbS). The potential occurrence of non-acid producing sulfides coupled with the high acid neutralization potential of the samples may explain the incongruous relationship between ABA and pH in the samples.

Table 9. Acid base account and sulfur forms from the Groundhog vegetation plots.

						Extractable Sulfur Forms				
Sample ID	Depth (Inches)	ANP	AGP	ABA	Total Sulfur	H_2O	HCL	HNO_3	Residual	Paste Ph
		T/kT			(% Sulfur)					
South Vegetation Plot										
SVA-1	0-8	20	3	17	0.25	0.07	<0.01	0.1	0.07	7.2
SVA-1	8-20	157	110	47	5.78	1.25	<0.01	3.38	1.15	7.4
SVA-2	0-7	24	5	19	0.40	0.11	<0.01	0.16	0.13	7.4
SVA-2	7-19	114	83	31	5.38	1.32	0.55	2.54	0.97	7.2
SVA-3	0-10	18	4	14	0.29	0.08	0.02	0.13	0.06	7.3
SVA-3	10-22	164	79	85	4.85	0.88	0.48	2.44	1.05	7.4
Middle Vegetation Plot										
MVA-1	0-5	33	5	28	0.24	0.04	<0.01	0.16	0.04	7.5
MVA-1	5-17	51	57	-6	4.53	1.18	0.98	1.76	0.61	7.4
MVA-2	0-5	15	3	12	0.16	0.03	0.01	0.09	0.03	7.4
MVA-2	5-17	57	74	-17	5.45	1.56	0.81	2.28	0.80	7.3
MVA-3	0-7	30	6	24	0.32	0.06	0.01	0.18	0.07	7.6
MVA-3	7-19	106	80	26	5.58	1.14	0.69	2.45	1.30	7.4
North Vegetation Plot										
NVA-1	0-5	15	2	13	0.15	0.04	0.01	0.05	0.05	7.5
NVA-1	5-17	36	56	-20	4.01	1.13	0.66	1.71	0.51	7.0
NVA-2	1-13	30	66	-36	4.95	1.55	0.48	2.03	0.89	6.4
NVA-3	0-7	27	1	26	0.04	0.01	<0.01	0.02	0.01	7.6
NVA-3	7-19	31	63	-32	5.13	1.53	0.92	1.93	0.75	6.3

ANP= Acid neutralization potential expressed as tons/1000 tons (T/kT) of calcium carbonate equivalent
AGP= Acid generation potential expressed as tons/1000 tons (T/kT) of calcium carbonate equivalent
ABA= Acid base account expressed as tons/1000 tons (T/kT) of calcium carbonate equivalent

4.0 CONCLUSIONS

The revegetation efforts at Groundhog have resulted in the establishment of a vigorous stand of perennial grasses that is consistent with the cover levels expected for this region based on the analysis of the vegetation plots. The vegetation success is considered to be good from a mid-term perspective (i.e., at 7 to 8 years), although the vegetation plots generally lacked shrubs and forbs. The scarcity of shrubs and forbs in the vegetation plots is probably related to the timing of the investigation (early growing season), antecedent weather conditions in spring of 2000 (relatively dry spring), and the composition of the initial reclamation seed mix. The original seed mix was not available for examination, thus the potential lack of shrubs and forbs in the seed mix is inferred. Plant composition on the site is expected to change over time in response to colonization by native species that occur in the surrounding areas.

The soil cover and underlying waste rock in the vegetation investigation area possess few inherent limitations with respect supporting native and locally adapted vegetation. The soil and vegetation data are interpreted to indicate that adequate revegetation can be achieved with a 6- to 12-inch thick native soil cover placed over waste rock.

5.0 REFERENCES

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APPENDIX B

FIELD NOTES

6/12/00
Jen Pepe

7:00 Arrive in field at Groundhog Location

Weather sunny and warm.
No track-hoe at site. Charlie Hammond @ Hamilton Construction and Curtis Cross are at site. We discussed getting a utility locate done, Curtis says they are suppose to be done by noon today. Curtis wants to begin excavation at 62 or 63 where there are not likey to be utilities. We also checked out pipelines where they are exposed. The track-hoe cannot drive accross buried pipelines because it is too heavy. Pipelines are in a 15'-20' wide array and marked at the surface with a stake.

6/12/00
JP

8:00 Curtis has transferred all supplies to my truck, equipment needs decon. Trackhoe arrives Charlie and George and Curtis discuss health + Saftey, then leave site with George.

8:30 George Shepard arrives back on site. We discuss sampling processes. 235 Cat Excavator will be used for deeper holes.

8:45 Curtis calls to say that we will have utility locate at the site in about an hour. He wants us to wait until they survey before beginning digging.

Located pit locations on stockpile 62, deconned equipment.

10:30 Still waiting for utility locate.

6/12/00
JB

11:15 48 hours after call to utility locate, Ok to dig.

Begin digging at Test Pit 63-4
Samples will be collected at 2' intervals.

Topsoil is about 12" thick, roots extend to several inches below the interface with waste rock.

2' depth - collect ≈ 2 gallons of material.
Material Description: 85% angular cobbles + boulders up to 12" long. Cobbles are porphyry with gray groundmass (GM Gley) with blue occasional phenocrysts.
Matrix is weathered to yellowish orange, slightly moist angular sand with fines (SM), no cohesion, loose, moderately plastic when wet.
~~Gra~~ Cobbles fizz w/HCL when

6/12/00
JB

scratched - maybe dolomite, one sample has black octagonal prism shaped crystals.
Overall sample is GP - primarily graded gravels.

11:55 collect next sample from 63-4 4' depth. Sample is moister, darker, and more fines.
Sample description - Gravel (50%) with sand + silt, minor clay in matrix (GM). Cobbles are primarily limestone and dolomite, some with pyrite crystals. Minor cobbles of Galena + pyrite with copper hydroxides. Matrix is 2.5YR 5/3 (brown), moist, loose, ~~no~~ slightly plastic when wet, fizzes with HCL, sandy.

12:15 Sample 6' depth. Material is the same as the 4' sample, but, sample is moister and cobbles and matrix are weathered with iron oxides. Cobbles have a soft weathering rinds of jarosite or limonite. Slight fizz to matrix.

6/12/00

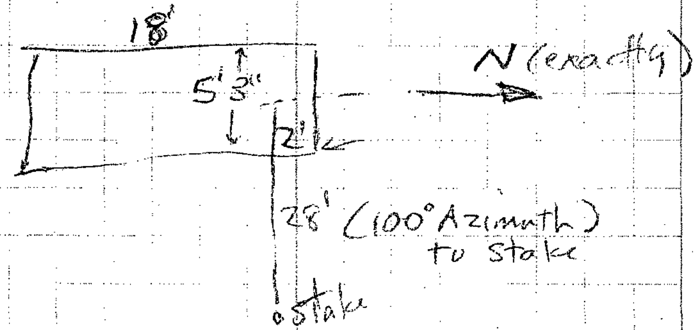
12:30 Sample 8' depth
Distinct change in particle size, cobbles are larger (25% > 10"), obvious in pit wall that a change in size + color occurs @ 7'.
material descriptn: GC, very moist. Cobbles are blocky and angular, mostly dolomite, limestone, mudstone, and pinkish fine grained granitic (could be a sandstone).
Cobbles ≈ 60% of material.
Matrix is SC with globules of brownish clay weathered from mudstones (?). Varying colors.

12:50 Sample @ 10' depth.
Sample similar to above but more granitic cobbles. Globules of reddish brown clay up to 10". Sample collected includes clay and sandy matrix. Matrix fizzes w/ HCl.

13:05 Hit bedrock – pinkish green fine grained – 11'7"

6/12/00

Final pit configuration:
G3-4



13:50 Composited samples. (G3-4)
Samples from the 2', 4', and 6' intervals were similar and composited into $\boxed{\text{U-03-52-02}}$ by placing each subsample on plastic sheeting and "coning". About ~~8~~ 1 kg was collected using clean gloved hands and placed in double baggies and labeled. Another identical sample was collected for archive at Chino. The same process was repeated to composite the 8' and 10' samples into $\boxed{\text{U-03-52-03}}$. More notes will be summarized when George leaves site.

6/12/00

11:00 Move to hole G3-3
Rain storm is moving close.
Curtis decides that it's ok
to start hole + leave it open
overnight.

14:05 Collect 2' sample at hole G3-3
sample is 50% cobbles + boulders.
Overall sample (GC) - Cobbles
are limestone, dolomite, rock
that looks like porphory w/
feldspar phenocrysts, but knife
scratches ~~no~~ groundmass (green).
A few cobbles ~~f~~ have veins
of galena + pyrite crystals,
with blue weathering rind. Matrix
is gravelly sand with clay,
plastic when wetted. Some
massive cobbles (>2') cemented
together with iron (?).
Samples is light brown - Slightly moist.
Matrix fizzes w/HCL
Root zone in pit extends
below soil cover (6"-12" thick)
Roots into waste rock ≈ 4"-5"

6/12/00

14:45 Sample 4' depth
GC - Cobbles are limestone,
dolomite, and granitic rocks.
Matrix is iron oxides, sand, +
silt. Cobbles have thick soft
weathering rind of iron coating
Coating is 10YR 5/8 (orange).
Matrix is highly plastic, and moist.
Weak fizz w/HCL.

15:00 George digs out 6' and 8'
samples, and secures the pit
by covering it with the arm
+ bucket + taping it with
hazard tape. George and
Charlie leave site, due to
rain and occasional lightning strikes
in distance. I collect samples
from the two piles, label the
bags, and cover gear with
plastic. Move to truck
until rain stops. Pit is down
to 10', ready for next sample.

15:20 Curtis leaves site.

6/12/00
JP

15:40 Still raining

Observations from first pit (G3-4)

① Sampling strategy is working: Logistically: George digs to the next depth to be sampled and waits for me to finish descriptions and sub-sample collection, then I measure the depth to confirm. He is usually accurate to about 2".

② No thin beds are observed in pit walls. Beds are defined more by staining than geology. Iron staining is yellowish and orangish in lenticular beds down to about 7', when the beds become more coarse grained and clayey and brown. This may be the original surface, but it looks mixed or smeared. Cobbles are angular as in waste rock. At about 9½', cobbles decrease in size and pinkish gray granitic bedrock cobbles appear in soil. More likely this is the

6/12/00
JP

original surface. Granite bedrock hit at 11'7"

③ The hole was staked and backfilled. Disturbed ground will be covered with topsoil at the end of the project.

④ Beds generally did not dip, however the excavation was parallel to the slope.

Other notes:

① Subsamples and samples are being collected with clean gloved hands to save time on decon, and because it is difficult to collect samples with scoops due to the range in grainsize.

② Cobbles larger than 3" are not being collected (generally) for analysis. Instead the fraction is estimated of cobbles + boulders in the subsamples.

16:00 Rain is letting up. Return to Pit G3-3 to log sub-samples from 6' and 8' depth.

6/12/00
JP

16:15 Material from 6' and 8' depths is similar to 4' depth in texture, moisture, color, etc. Only the lithology of the cobbles changes slightly with the 6' depth having as many pyritic porphory (gray) as carbonates, and the 8' depth having less than 25% carbonates, with cobbles of gray porphory groundmass with dense pyrite crystals, and quartz diorite also with pyrite. There is also granitic (pink and green) material, but it is very weathered, breaking with hands and cutting with a knife. No free w/HCl

16:40 pack gear, secure samples in truck.

16:55 leave site.

6/13/00
JP

7:05 – Arrive on site – unload gear. George Shepard + Curtis Cross on site. Curtis brought ice chests + labels/COCs. Weather is fair.

7:30 – Ready to begin sampling at 10' in pit G3-3. material description – same as 8' interval.

7:48 – Sample 12' depth. material description: Same as above, but no carbonates found in cobbles. Thin white cyrstals and cobble surfaces common in plan of fractures + in cavities. up to 1/2" long, 1 mm wide, maybe gypsum(?) soft.

8:00 Sample at 14' depth. material description – more of the same as above (12'), change to slightly darker color as orangish matrix is mixed in the bucket with darker (gray) weathered granitics at bottom of hole. Cobbles are primarily highly weathered greenish granitic rock. Globules of orangish clay present.

6/13/00
JR

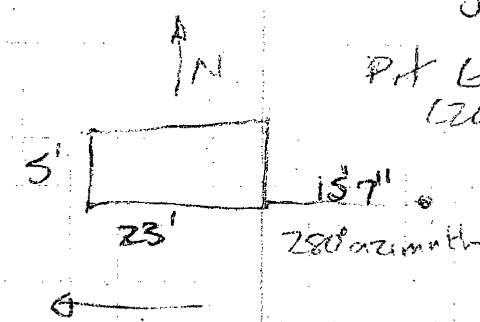
8:25 Sample at 16' depth.
Material description: Change from above, material is not as weathered, 50% cobbles + boulders, matrix is sandy gravel with fines. Overall GM. ~~Matrix~~ Cobbles are various shades of ~~light~~ gray on weathered surface. Matrix is mix of weathered gray + some iron staining, only trace amts of clay. Cobbles are predom. weathered greenish granitic or amorphous siliceous material, with minor cobbles of mudstone.

8:50 Sample @ 18' depth
material description: Same as above with slightly more ~~matrix~~ (still GM) and some globules of clay. Cobbles are 5% blocky light brown mudstone.

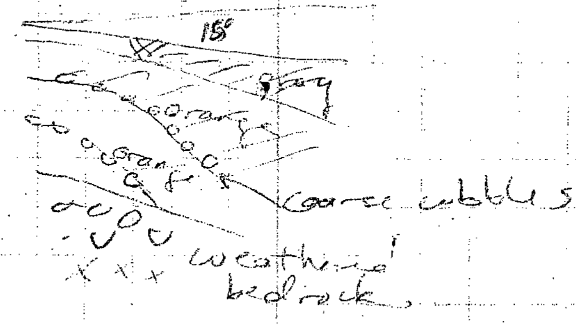
8:55 Hit bottom of the hole (refusal). at 20' - sample is same as above by includes unweathered granite (pinkish green) as well as weathered.

6/13/00
JP

Pit 63-3
(20' deep)



down hill 15° dip, beds dip with slope or greater (up to 25°)



Staked hole + photographed stockpile

9:30 Composites: (1) Top 2' (grayish LS)
orangish 4', 6', 8', 10', 12' (2)
(grades to less ls cobbles but essentially same material)
16', 18', 20' - darker granitic.

(14' depth was "smeared" from material above + below. Not composited)

6/13/00 JR

10:00 Finish compositing + bagging
Pit G3-3 samples (same methods as
yesterday.)

G1-03-52-04 - 2'

G1-03-52-05 - 4'-12' composite

G1-03-52-06 - 16'-20' composite.

Move to next hole.

10:20 Begin excavation at pit
G3-2, in center of G3
over old drainage. Root zone
6" - 18" (SE to NW), few roots.

10:25 Sample at 2' depth
Material description: 40%
cobbles/boulders - G~~X~~. Matrix
is Gravelly Sand, orangish brown
slightly moist, plastic when wetted.
Cobbles are primarily limestones
+ dolomites with few granitic
or porphyry w/ pyrite crystals.
Matrix fizzes w/ HCL.

6/13/00 JR

10:35 Sample @ 4' depth
material description: Change in
color to light brown
(10YR 6/3) cobbles are iron
stained. Same texture as 2'
depth. Cobbles are predominately
limestone, highly mineralized with
pyrite + galena. Few granitics.
Matrix Fizzes w/ HCL

10:50 Sample at 6' depth.
Sample description identical
to material in G3-3 at 4'.
Weak fizz, orange staining.

10:59 Sample @ 8' depth
(Same as 6' depth at G3-3)
Grading into less limestone +
dolomite (less than 40%), more
highly weathered to slightly
weathered granitic rocks
(some quartz/feldspar + some
greenish porphyry w/ felspar pheno-
crysts. Fines do not fizz.
~~Granit~~ granitic cobbles break apart in
hands.

6/13/00

11:13 Sample @ 10' depth
material description: Weathered granite. Most material is cobbles so highly weathered that they break in hands and smear ~~it~~ like clay, can be molded. Color ranges from mostly orange to dark brown + pinkish. Appears to be highly weathered bedrock. Crystals are recognizable but then can be molded with fingers. (GC), moist.

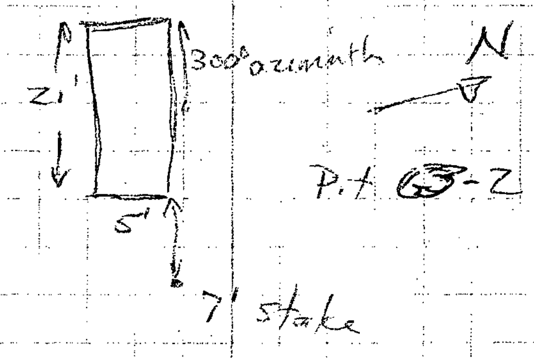
11:35 Sample @ 12' – same as above.

11:40 Sample @ 14' – hit interface between weathered granite (above description) and dark brown silty ~~sandy~~ clay with sand (MH). Bucket sample is mixed, not sampled for analysis. Clayey layer has roots and is very moist, silt layers are saturated, no particular smell. Very minor amounts (flecks) of white + orange precipitants at contact w/clay.

6/13/00

11:50 Sampled again at 16' (Pit bottom @ 17'3" – refusal) Original soil is slightly mixed with yellowish clays. Representative sample collected. Cutting into a globule of clay, small flecks of orange are present.

Bedrock @ 17'3" is pinkish green granitic rock.



12:30 Sketched photograph site G3-2, begin filling pit. I will move to next hole + begin digging while George is still here and come back at 3:00 to composite samples. (continued)

6/13/00
JS

12:30 Sub Samples from G3-2 will be within view and are covered with plastic. Subsamples will be composited as follows:

7 ① 2'–4' (Carbonates, matrix fizzes)
8 ② 6'–8' (Orangish, granitic cobbles)
9 ③ 10'–12' (weathered Granite)
10 ④ 16' (Underlying Soil)

Cu-03-S2-07 thru ~~-010~~ -10

1245 move gear + backhoe to pit G3-1.

13:00 Begin digging G3-1 on surface with no topsoil or vegetation. Cobbles at the surface are siliceous, ~~red~~ ~~jasperoid~~ chert cobbles. Slope is possibly hard to keep topsoil on.

13:05 Sample 2' depth. Looking at hole, the topsoil material is actually the brownish matrix with ~~jasperoid~~ chert cobbles. it is 4" to 6" + contains no roots. Immediately underlying is yellow layer which smells slightly sulfurous

6/13/00
JS

13:10 2' depth material description GC – 30% cobbles + boulders cobbles are all siliceous, either red chert ~~jasperoid~~ or viened w/ mineralization primarily pyrite in clusters or disseminated, crystals less than 1/4" wide. Matrix is yellow stained (5YR 7/4), gravelly sand w/ clay coatings, becomes plastic when wetted, smells like sulphur. moist

13:20 Sampled at 4' depth, same as above, but with 50% cobble weathered granite. Granite is so weathered it is mostly clay, some secondary mineralization is possible (orange + purple clays in place of original crysts. Some globules of light yellow clays.

6/13/00

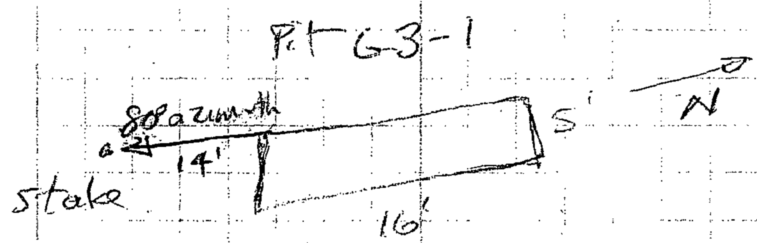
13:45 Sampled at 6', hit original surface, very thin reddish & brownish clayey soil. Reddish coating on rock (cobbles same as above). Brownish clayey silt and sand with roots similar to that seen at base of G3-2. Although the sub sample is smeared with material above the original soil was carefully sampled from pile. most

14:00 Sampled @ 8' depth
20% cobbles/boulders in matrix of light brown GP with some fines, slightly moist, weathered granite (greenish pink). Loose, slightly ~~non~~ plastic. Roots present.

14:15 Sampled @ 9' - hit refusal. Same as above, but no roots, and some angular blocks of slightly weathered bedrock.

6/13/00

14:35. Staked + measured pit. Photographed



Samples will be composited as follows:

① 2', 4' ~~6'~~ - yellowish orange, sulfur smell.
② 8' - underlying soil
③ 9' underlying parent material.
(6' was too mixed to use)

14:50 - Begin compositing + bagging samples at Pit

2' and 4' subsamples → $\boxed{\text{U-03-S2-11}}$
8' sample (soil) $\boxed{\text{U-03-S2-12}}$
9' sample (underlying) $\boxed{\text{U-03-S2-13}}$

15:20 - Transfer samples collected thus far to Curtis. He will do COC form. We found the Archive sample for U-03-S2-02 was mislabeled as -03. Problem corrected.

6/13/00
JB

16:05 Curtis leaves field. We discussed project status & he agreed that we needed to get piles defined with sufficient exploratory pits. He would rather define the problem than cut scope to save budget. We also agreed to use the excavator until the end of the week on this project, focusing on completing deep pits and exploratory pits at the toes of the bigger piles and the area of G3-1, where drainfield material will be stockpiled next week.

16:15 Begin compositing samples from G3-2 as follows:

u-03-52-07	= 2'-4' composite
u-03-52-08	= 6'-8' composite
u-03-52-09	= 10'-12' composite
u-03-52-10	= 16' discrete

16:50 Leave site

6/14/00

7:00 Arrive on site at pile G-2. Unpack gear. Kent Johnejack, Curtis & George on-site. Chose hole location with George.

7:15 Begin excavating pit G2-2

7:15 Surveyors (Engineer, Inc) Arrive to inspect site, Kent goes to coordinate with them.

7:20 No topsoil discernable from the stockpile material to 2', No vegetation is growing in the area chosen for the pit.

7:30 Stop to speak with Armando and Roberta with Eng., Inc. about Survey. Estimate about 100 point plus shafts, culverts. approx ½ day of work. They will create own reference point if Chino doesn't provide one. They will meet me on Wed. afternoon & survey then on Thursday morn.

6/14/00

7:55 Continue pit G2-2.
Sample at 2' depth
material description GC.
Approx. 50% cobbles + boulders,
up to 3' boulder (Tuff.);
other cobbles are granitic, fine
to corse grained pink + white,
porphery with pyrite phenocrysts
and small (< 2') cobbles of copper
hydroxides (?) blue.
Matrix is GC with sand. Very
moist + very plastic, dark
brown. Clays often in globules
with iron oxides visible (red + orange)
8:10 Sample @ 4' depth
sample description - sample same
as 2' depth
8:15 Sample 6' depth
Sample description: Same as
above, except less tuff
cobbles + more mineralization
in clay globules (up to 1' diam)
Mineralization is blue copper minerals
+ red and orange iron oxides.

6/14/00

8:30 Sample @ 8' depth
sample description - same as
above, more tuff (largest
cobbles are tuff). Tuff cobbles
are rounded, others are angular.
Mineralized siliceous + porphery
rocks show thin veins of
chrysocola & galena + other
associated minerals. Although
large globules of clay are
present, cobbles do not have
a thick weathering rind +
are only highly weathered along
fractures + cleavage.

8:42 Sample @ 10' depth.
material description: Same
as above. Clay globules up
to 2' long, 1' wide, decrease
again in Tuff.
9:00 Mark Birch shows up,
helps confirm lithologic id's.
"Pinkish Greenish" granite id'd
previously is mostly feldspars,
accounting for the clay
products of weathering.

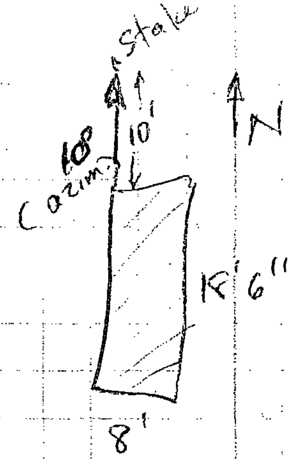
6/14/00

9:30 Back to Pit G2-2, depth 12'
material description. change
at 12' - smeared sample
hit contact w/underlying
surface at base of layer (photo)
weathered granitic or tuff,
fine grained layered weathering
bedrock ~~is~~ (pale pink + dark
reddish brown) is parent material
for this soil, roots throughout
(no subsample collected - mixed)

9:40 Hit bedrock at 14'. (sampled)
Material description:
black siltstone (2YR8/1), no
bedding apparent, rock fragments
from <1' to 1', weathering
rinds iron stained (2YR 6/8).
Sampled fines fraction, reddish
brown, no plasticity, dilatent
when wetted. ~~B~~ Slightly
moist ~~wet~~ fines.

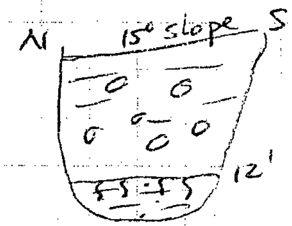
10:00 Sketched + photographed hole.

6/14/00



Pit G2-2

10:00 Fill in hole, begin compositing
samples as follows. (G2-2)



pit x-sect.
2 composites.

U-03-52-14 2'-10'
Composite

note: 12' sample - smeared between
overlying layer + underlying

U-03-52-15 - underlying weathered
siltstone, 14'

10:30 Finish compositing, Phil
Harrison from NMED shows up
after samples are collected
+ bagged, hole is filled. we
talked about project status

6/14/00
JS

10:30 (continued). Discussed with Phil included what has occurred during field work.

11:00 Begin Pit GZ-1. Sample of 2' depth. light Brown
(GW) 20% cobbles + boulders / some angular some rounded tuff. Angular are siliceous granitic or porphyry w/feldspar + pyrite phenocrysts, some glassy tuff cobbles (bleeding run?), clods of dirt that break apart with hands, but matrix is moist, mostly loose, gravelly sand, no plasticity; subrounded, mostly (50%) coarse sand, quartz + accessory grains (feldspars, micas.) Root zone is 1'-18" with Root to several inches below

11:20 Collect 4' sample - Same as 2', more rounded cobbles.
* So far looks like fill material.

11:35 Collect 6' depth
(continued)

6/14/00
JS

11:35 Same as above except more angular siliceous cobbles compared to round tuff. Tuff is both pinkish fine grained and glass coarser grayish red. This bucket had a plug of clay with roots, dark brown with some yellow iron oxide precipitates. Looks like a mix of fill and some soil with minor amounts of porphyry with pyrite. Sampled mixed material, as that is how it occurred in pile.

11:50 Sample @ 8' depth

Stop to locate next pit with Curtis + Phil + show phil old aerial photos + Tom Shelley's maps of the relocated material.

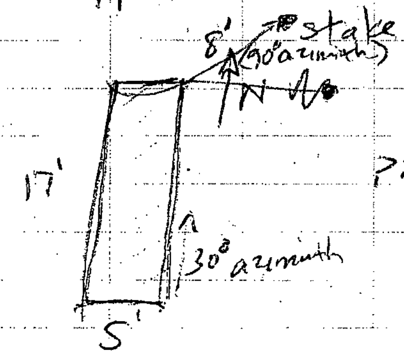
12:20 Return to Pit GZ-~~[illegible]~~ 1
8' depth is mix of fill above and gray siltstone (as in pit GZ2, but intruded by →

6/14/00

12:20 continued iron-rich viens of quartz. Photo.

Pit bottom is at 9½'
Sampled @ ~~9½'~~ @ 8' but not weathered bedrock.
8' sample is root zone.
weathered bedrock is mostly chipped rocks.

12:35



Pit GZ-1

12:47 Hole being filled. Photoed + sketched. Begin bagging + compositing samples as follows.
2', 4', 6' — composite fill
8' — sampled root zone discretely

$\boxed{\text{U-03-52-16}}$ 2'-6' composite
$\boxed{\text{U-03-52-17}}$ 8' discrete.

6/14/00

13:07 Begin Pit G~~1~~-3
Sample @ 2' depth. Root zone extends 3½' through fill mixed with some clays with yellow precipitates. Collected 2' sample from wall of pit to get accurate depth.
Material description is light brown sand with gravel, cobbles are siliceous granitic or porphories, mudstones, + tuff. Cobbles are angular except tuff. Greenish pinkish granite and white quartz/feldspar granite occur. Not much mineralization in cobbles. Matrix is mix of gravelly sand (slightly moist) and globules of dark brown clay with many roots. Clay has yellow/white staining, moist

13:45 Sample @ 4' depth
Material description: Conglomerate with mudstone, feldspars(?), + mica + crystaline lithics, cemented — firm to soft (breaks easily with some difficulty with hands.)

6/14/00
JB

13:45 (continued) Conglomerate –
2.5YR 7/3, fine sand to ~~cobbles~~
gravel less than 1" diam. ~~Ba~~ Some
preferred orientation in some layers,
which are irregular, and some
with no bedding. ~~Ang~~ Subangular
to subrounded. Slightly moist.

~~14~~:05 Sample @ 6' depth.
Same as above. Some
larger cobbles of Tuff, porphyry.
14:15 Sample @ 8' depth.
Same as above.
* No pyritic rocks in this hole.

14:40 Sample @ 10' depth
Same conglomerate, more
cobbles – Tuff, siliceous
cryptocrystaline, and pink/
green granitics, up to
8".
14:50 No sample collected at
12' – same material,
looks like natural deposit,
no indication on mine-produced.

6/14/00
JB

15:15 No change in ~~the~~ lithology
(generally) down to 18', I
stopped detailed logging at 12'.
Curtis and I want to tag
bedrock. Phil is happy to
stop anytime.

15:15 Stop excavating Pit GL-3 @
20'3". Tape off hole w/
hazard tape. George leaves.
15:25 – Phil leaves, says he'll
be back tomorrow.
15:30 Curtis leaves.

15:32 Sampling strategy for this
hole will be as follows:
2' – discrete sample collected
from wall appears
to represent disturbed
material that extends to
about 4' (irregular contact)
4' – discrete sample of conglomerate
(sand + pea-size gravel)
6' – discrete sample of conglomerate
to hold for analysis in the
case that the 4' shows any
impact.

6/14/00

15:40 The sampling strategy for G1-3 is acceptable to Curtis and Phil, given that the conglomerate material extends to below 20' and shows no mining-related rocks or precipitates. Moisture increases slightly with depth, but only moderately moist at 20'. We will try to tag bedrock in the morning.

15:43 Begin bagging samples. G1-3

~~U-03-52-18~~ - 2'

U-03-52-19 - 4'

U-03-52-20 - 6'

16:02 Completed sample bagging. Move samples to ice chest, pack sampling gear. Photo of conglomerate (typical)

16:30 Finish packing, climb hill above G1-3 to look for possible source of conglomerate material. Hillside is Tuff. No sign of mudstone outcrops.

6/14/00

16:40 Measure back stake at G2-1 to edge of pit.

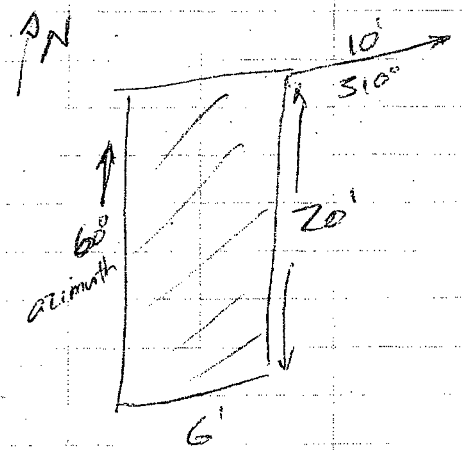
16:50 Leave site

6/15/00

7:00 Arrive on-site at Grandview. Pit G1-3, at 20' deep. I suggest trying to tag bedrock, in the case that the conglomerate is a fill material, we should make sure it's not covering any mine materials.

7:15 Begin digging

7:45 Stop digging at 24', hit more conglomerate, weathered, wet chunks. Clays are weathering



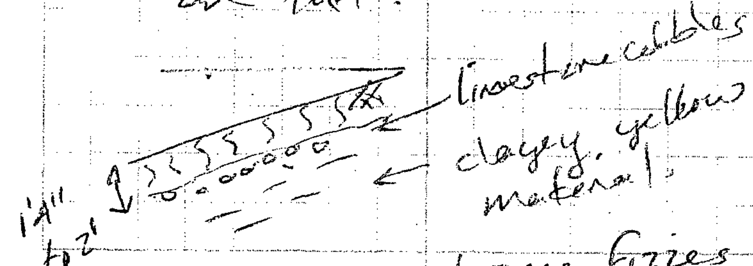
from the mudstones, feldspars in the conglomerate. Chert cobbles, light gray (up to 6"), no mineralization

6/15/00

7:51 We are close to bedrock, reach on excavator is maxing out. sketched hole + photographed pile.

7:25 Move to Pit G1-2, could not locate on steep hillside due to power lines. Move to just uphill of powerline by telemetry station. Collect 2' depth sample.

Topsoil is light to dark brown gravelly sand with fines, slightly moist to moist from top to bottom 1'4" to 2' thick, roots extend to up to 3" into waste rock. Cobbles at surface + topsoil are tuff.



Topsoil in root zone fizzes w/ HCl. Overlain by LS cobbles from <1" to 5" →

6/15/00
JR

8:50 light gray LS cobbles are mixed ≈ 4" into top of waste material. Waste material is yellowish ~~$~~ (2.5YR 8/4) ((~~SP~~) gravelly sand with clay weathered from felspars, some quartz grains, slight sulfur smell. Some limestone cobbles are cemented to very firm, can't break with hand. Sampled (subsample) collected of mixed zone of LS + waste rock. moist

9:05 Sampled @ 4' depth. ~~GW~~, 60% cobbles, mainly limestone (80%), Tuff (10%) + minor ~~mineralized~~ quartz viens with pyrite, chalcopyrite, galena (xtals < 1mm), and mudstone ~~cobbles~~ Boulders up to 18" (tuff). Matrix is gravelly sand, varying from light brownish gray to yellowish gray. Fizzes with HCL. Mod. plastic

moist

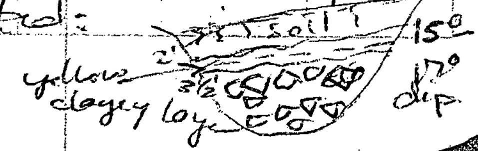
6/15/00
JR

9:05 (continued) Few clods of cemented dark brown mud with minor gypsum (?) crystals on surface.

9:15 Sampled to 6' depth. Same as above, large blocks of Tuff. Timber fragments. Dry. LS + Tuff cobbles only, no ~~waste rock found~~. Strong fizz w/HCL. Few small cobbles (≈1"-2") w/ mineralization (pyrite).

9:30 Hit bottom at 7', refusal at tuff bedrock interface. No original surface soil or root zone, lumber at bottom of hole

Variability on wall of pit is more distinct than seen in bucket samples. 3 descrete samples may be warranted:

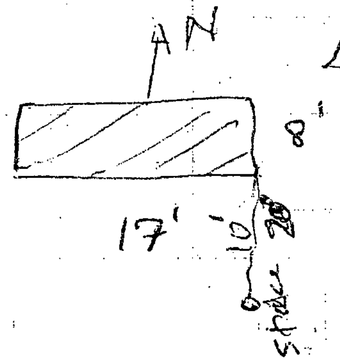


6/15/00

9:30 (continued) 3 samples would show potential effect of leaching. Compositing 2 lower samples would make it hard to see change with depth + impact to underlying surface.

9:50 Measure + sketch hole.

Pit 61-2



10:05 Bag samples. I will bag 4' and 6' as discrete samples + they can be composite later if Chino decides to.

u-03-52-21 2'
u-03-52-22 4'
u-03-52-23 6'

6/15/00

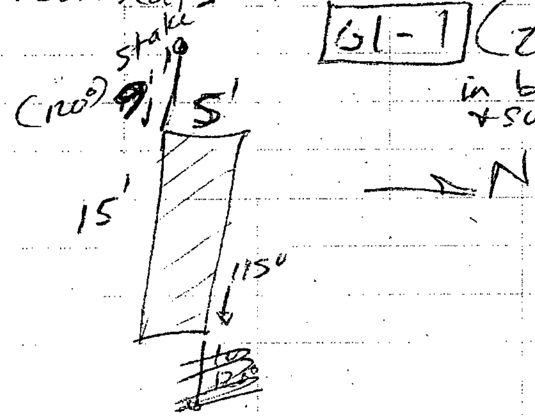
10:40 Moved to pit 61-1, begin digging. Root zone

10:45 Sample @ 2' depth.
GC stained reddish to yellowish slight sulfur smell, cobbles 5" (one large tuff boulder 2½') ~~Most cobbles~~ (30% cobbles/boulders) ~~most~~ Most cobbles are quartz/feldspar granitic to quartz chert with mineralization (pyrite, bornite, accessory) mostly disseminated fine pyrite crystals), also cobbles of Tuff (20%). Matrix is sandy gravel with clay, clay in globules sometimes around weathered granite. Clays are stained yellow w/ orange precipitates locally highly plastic. Matrix in general is moist.

Root zone is 12"-4", dark brown with scant vegetation, roots extend to base of topsoil.

6/15/00
JP

11:05 Sample at 4' depth. Hit bedrock @ 4 1/2' (Tuff.)
4' material description:
GC - mostly weathered tuff, cobbles break apart in hand or mold into plastic clay, cobbles are stained yellowish in thick soft rind. Few siliceous cobbles. Cobbles/boulders ≈ 30%. Matrix is gravelly sand w/clay ranging from dark brown to pinkish to yellowish. Sample represents mix zone of original surface, including a thin soil layer, highly weathered parent material.



$\boxed{61-1}$ (20° dip in bedding + surface)

6/15/00
JP

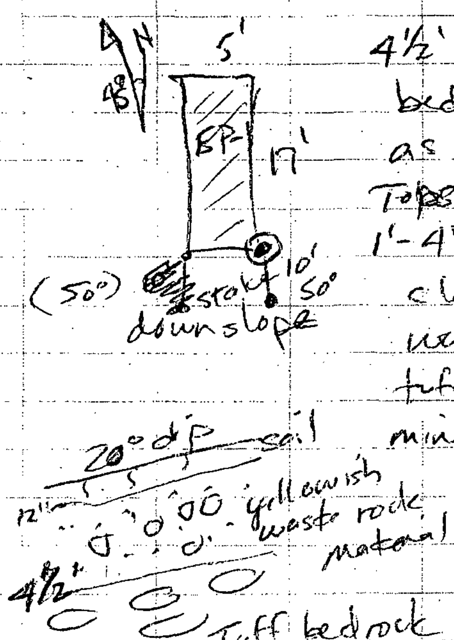
12:05 Bag samples as follows:
Pit 61-1
$\boxed{U-03-52-24}$ – 2' waste rock
$\boxed{U-03-52-25}$ – 4' weathered bedrock

12:20 Discuss schedule with Curtis. He thinks we will finish next wed. I think probably thursday. We will wait to hear from Kent. He agrees we should do exploratory pits for this week.

12:30 Exploratory pits will be numbered in sequence EP-1 EP-2, etc. and marked on a map to give to the surveyors. To maximize the number of pits, minimal logging and no Pit Forms. I will measure depth, describe material generally, measure orientation + dip of pits, and stake for survey. Sketches will be included in this logbook.

✓ 6/15/00 JP

12:40 EP-1 S. end of G1, w/in pile to check depth, edges of south side are well defined. Can use aerial photo to delineate. Check with Curtis on whether photos will be available or should I stake the edges for survey.

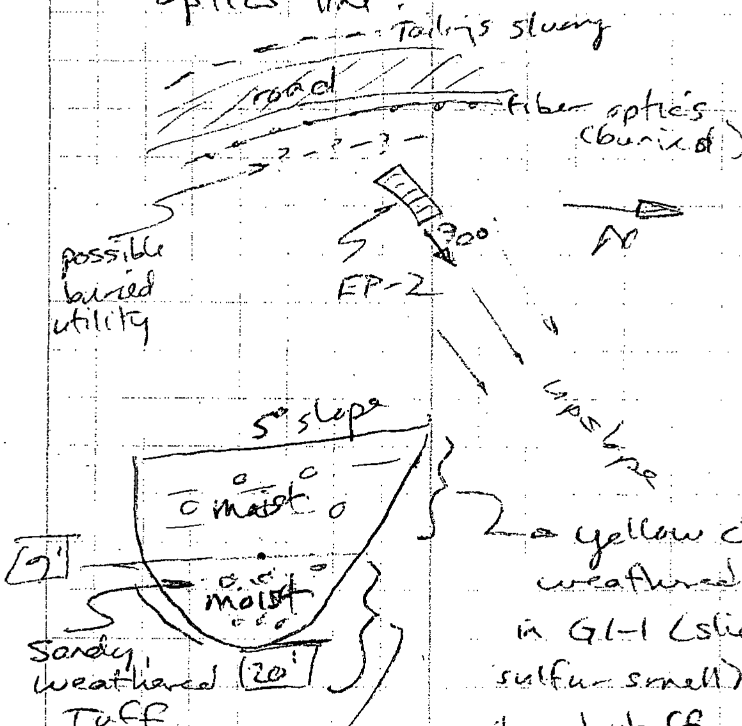


4½' to tuff bedrock, same as G1-1.
Topsoil 6"-12"
1'-4' yellow stained clayey weathered waste rock with tuff and siliceous mineralized cobbles.

Refilled hole, back survey stake to ~~SE~~ SW corner of pit.

6/15/00 JP

12:58 EP-2 SW corner of G1, toe of pile. George watched across area, which next to the road on the east side. (Tailings line on west side). He thinks there is another pipe east of the fiber optics line.

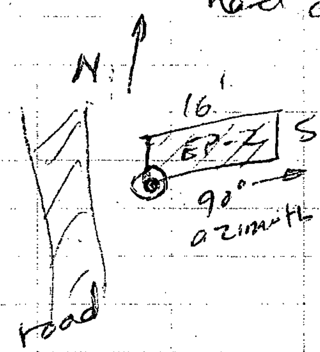


yellow clayey weathered as in G1-1 (slight sulfur smell)

weathered tuff (loose w/ subangular to subrounded cobbles) Looks like similar borrow pit wall nearby.

6/15/00

13:50 EP-2. Nearing bedrock at hard digging, mostly tuff bedrock cobbles



Stop @ 20'

stake @ SW corner.

14:05 George + I locate next pit location. No more pits can be excavated near toe of southern portion of G1 because of overhead lines and underground lines.

14:15 Move to EP-3 middle of toe of G1, below knob of hill with ~~powerlines~~ powerlines on it

14:25 10 min delay while excavator gases up.

14:30 Begin EP-3, 4' down stopped to inspect excav. material. Few limestone cobbles in yellow weathered clayey mineralized material. Most cobbles are massive sulfides — ~~black~~ ~~pro~~ dark gray →

6/15/00

porphery w/ pyrite encrusted. Slight sulfur smell. Also lighter quartz feldspar granite (highly weathered)

14:45 Sampled at 2' to get pure sample of yellow, clayey layer. This layer occurs in thinner more mixed intervals in G1-2 and G1-1 and in EP-1 and 2. This is a thicker interval with minimal mixing & represents worst case.

15:00 Stop digging at 13', just hit conglomerate (pea gravel) material encountered in lower interval of Pit G1-3, but it's slightly yellowish, moist, & weathered. Contact is about 13', We will continue in the morning.

15:45 Prepare sample from 2' discrete depth @ EP-3

$\boxed{\text{U-03-52-26}}$

16:00 Leave site

6/16/00
JR

7:00 Arrive on-site. weather sunny + warm. George is taking down hazard tape at EP-3.

7:10 Begin digging EP-3 @ 13'. Conglomerate @ 13' is somewhat more random (no prefered orientation of clasts. Looks like road fill. Same description as GI-3 conglomerate. checked for plasticity (none) because clasts are weathered soft. Some cobbles in conglomerate (15%), granitic or porphory, some pyritic mineralization

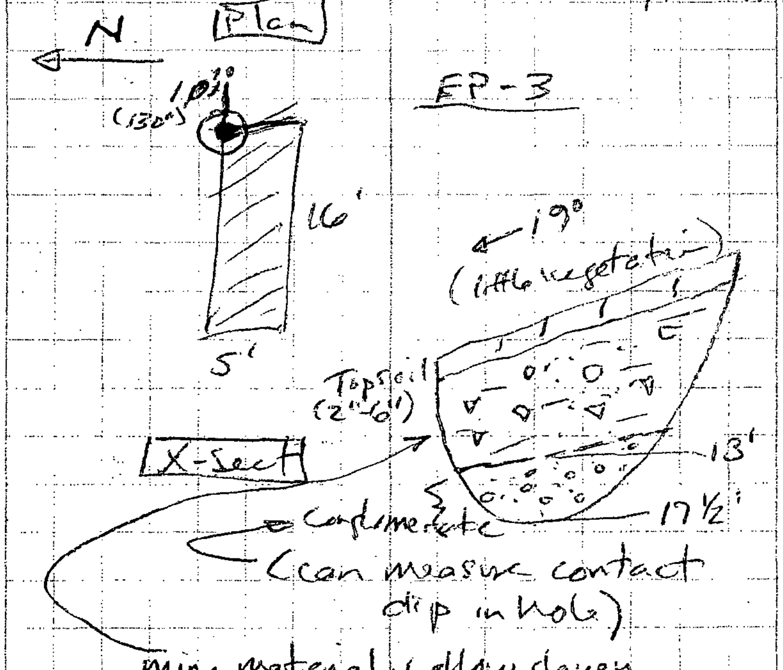
7:35 @ 17', conglomerate continues, some large boulders (up to 2') of grayish porphory with feldspar phenocrysts coming up with last couple of buckets

7:40 @ 18½' conglomerate matrix is slightly plastic

7:45 Cannot keep digging under fiber optics line, George needs to high a swing. Stop EP-3

6/16/00
JR

7:50 Base of lide is about at grade with pipelines (stake is ≈30' east, downhill, marking pipelines). Collect Geotech sample $\boxed{\text{EP-3-17'}}$
Collect analytical sample @ 17' for ABA/metals

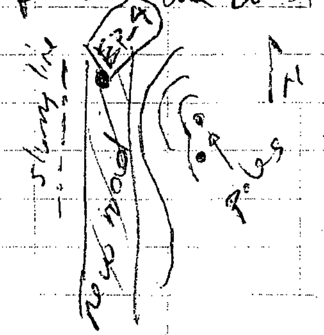


stake @ NE corner on hillside.

8:15 Fill in EP-3. Bag analytical sample from 17' (conglomerate)
$\boxed{\text{U-03-52-27}}$

6/16/00
JP

8:35 Locate EP-4 between the powerline on the knob of G1 and the tailings pipeline to see if I can define the slope of the wasterock.

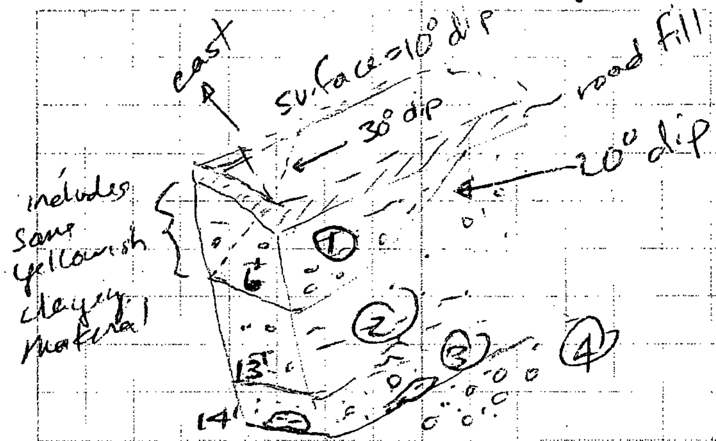


8:40 Back-surveyed stake at EP-3 on NE corner of pit.

8:45 Chino surveyor tells Curtis he will locate three reference points ① Telemetry pad ② near road/drainage intersect on G3 ③ downgradient of headwall.

8:50 Begin Digging EP-4
Road fill ≈ 3' thick, steeply dipping beds of mixed fill and clayey wasterock.

6/16/00



① mixed fill/waste rock, GC, moist with clayey yellow ~~beds~~ globules > 2' and, clayey brown soil with roots, and gravelly sand w/clay matrix. Cobbles are granitic (greenish, some quartz/feldspar, weathered. Mineralized cherty material with copper hydroxides + pyrite xtals. Matrix is reddish brown, plastic

② Essentially the same material except no yellow clayey layers.

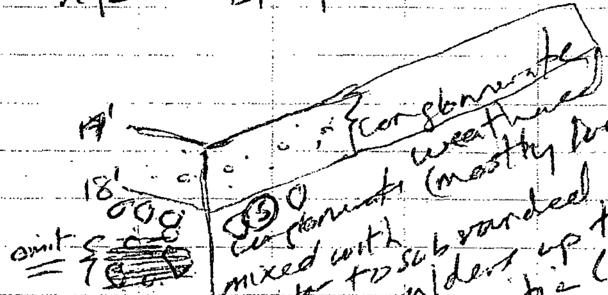
③ Grading to sandier, plugs of ~~black~~ dark brown clay with iron oxide mineralization on surfaces.

④ Conglomerate as in EP-3 @ 14'

(Continued)

6/16/00

9:45 EP-4



conglomerate weathered (mostly loose?)
(SS) conglomerate mixed with subangular to subrounded cobbles/boulders up to 1', mostly granitic (greenish with hexagonal mica crystals and porphyries with feldspar (not much mineralization)

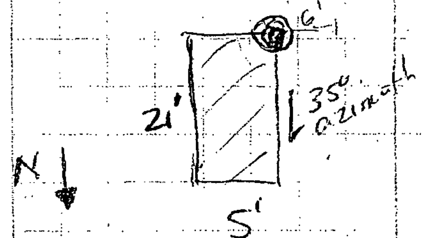
9:50 Sandy loose conglomerate continues with increasing amounts of siltstone cobbles (as seen at the base of G2-3) (Gray siltstone with jasper viens), most cobbles still siliceous, no mineralized viens.

* Note- Material is moist from base of roadfill down to bottom. Not saturated, clays are moldable at moisture content in pit

6/16/00

10:05 Maxed out reach of excavator at 21½', still in sandy conglomerate material. Did not tag bedrock.

EP-4



10:15 Back-surveyed stake at G1-3

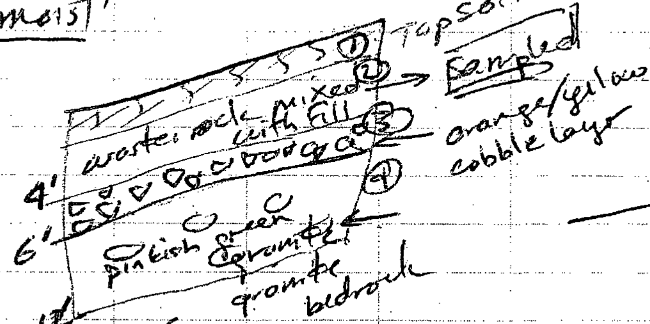
10:30 Hole (EP-4) is filled, place stake at SW corner of pit.

10:50 Begin digging EP-5 at toe of San Jose shaft hillside on G3.
Root zone is 1'-18", ~~too~~ in topsoil, no roots extend into underlying wasterock.
* Material at 2'-4' looks like a mix of the yellow sulfide material seen in uphill ~~G2-4~~ G3-1 and fill (orangish brown GC). cobbles are mineralized porphery (gray) and granitics, also red chert seen above

6/16/00

11:15. EP-5 contains lumber and other debris (5%).

all moist



② Mixed fill and yellow waste, sampled at 3' to see if it could be scraped + stockpiled as inert while removing underlying yellow layer. This layer contained timbers and had a slight oily smell.

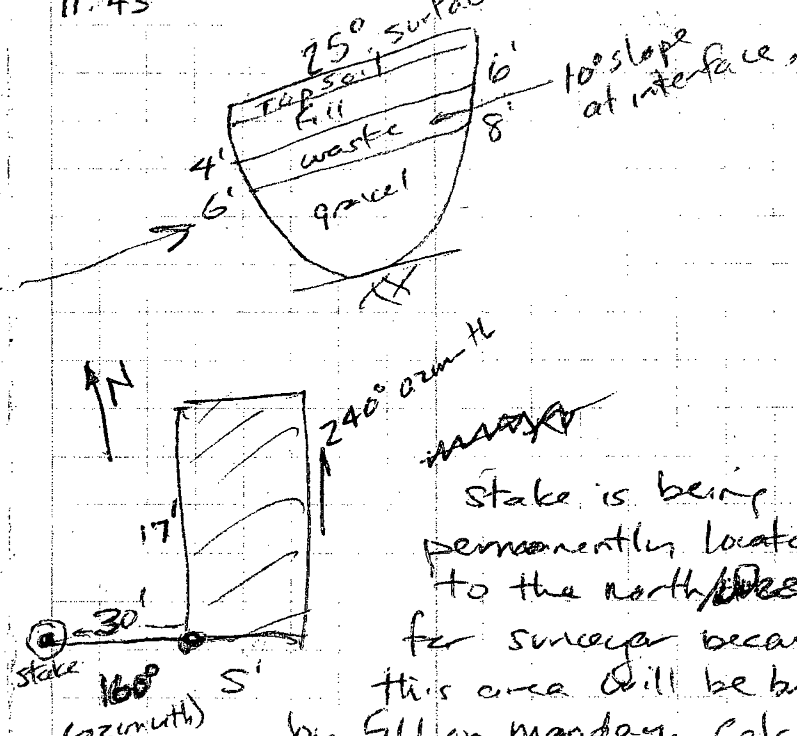
③ GC - wasterock, orangish weathering rinds + staining in sand, 80% cobbles/boulders of granitic to porphyry, highly mineralized with pyrite + copper minerals. This looks like the original toe of dump on hillside.

④ GM - light brown original slope material, sandy matrix, granite cobbles

6/16/00

EP-5

11:43



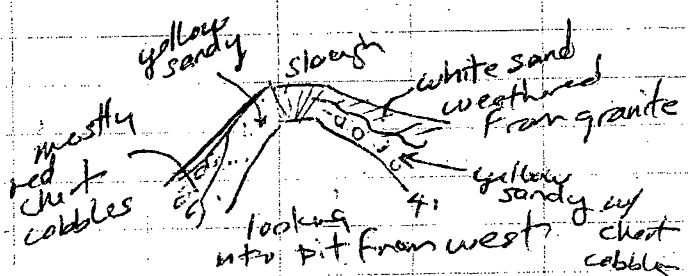
~~[illegible]~~ stake is being permanently located to the north/~~west~~ for surveyor because this area will be buried by fill on monday. Calc coords back to Southwest corner of pit.

12:00 Back survey G3-1 stake

12:10 Locate EP-6 on hillside east of G3-1, in grassy area. Root zone 12"-18" in topsoil, roots do not extend into waste rock.

JP
6/16/00

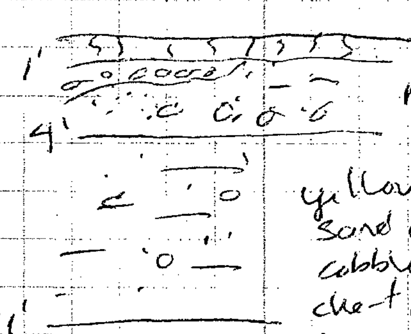
12:20 EP-6 @ 4' waste rock is similar to that encountered in G3-1 but sandier, more granitic cobbles (highly weathered) and less clay. Lenses of weathered quartz granite and red cherty cobbles. Looks mixed with other materials



★ Sampled at 3' (mixed zone)

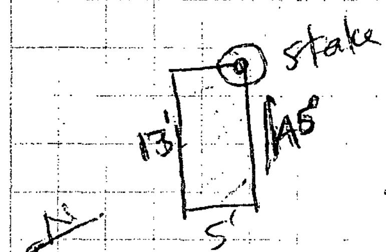
12:45 10½' @ EP-6, in yellow sand waste rock with plugs of mineralized clay, small cobbles of copper hydroxides, but most cobbles / boulders are chert (jasper), tuff, or granite (both greenish + white quartz/feldspar)

6/16/00
JP



yellow clayey sand with cobbles of tuff, chert, and granite (mineralized clay plugs, but no pyrite xtals in cobbles.

12:55 Hit bedrock @ 11½', same mineralized cherts.



EP-6

staked at SE corner

13:20 Begin digging at EP-7 at eastern toe of hillside where pit G3-1 is located (near "glory hole")

6/16/00

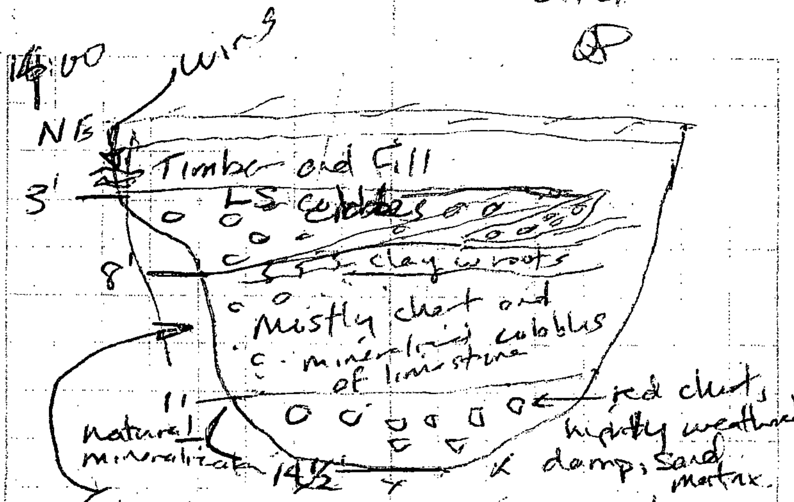
13:25 3' @ EP-7, hit layer of crushed limestone (up to 5") with timber + wires on top (under topsoil), timber also within limestones. Below 3' waste rock ~~xxx~~, GM mostly limestone cobbles with pyrite + chalcopyrite, some chert

13:40 5' Hit old root zone (?) in dark brown clayey sand. Still bringing up artifacts and limestone + chert cobbles. Some iron staining in matrix and rinds, but orangish color is becoming reddish brown. Copper minerals fairly common compared to other pits (azurite, malachite, chrysocola, etc.) in viens or as weathering rinds.

13:45 Delay to gas up excavator

6/16/00

14:00



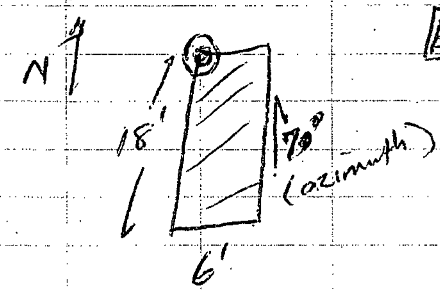
This layer is grading down to weathered cherty material, original bedrock. Malachite staining on fractures.

* note – matrix fizzes w/ HCl to about 12'.

14:15 Hit bedrock at 14.5'. Bedrock is chert (red jasper viens) which concentrates to the north near San Jose and becomes disseminated in siltstone to the south near No.1 shaft. Weathered in layers to a clay, indicating presence of feldspars originally (?). This layer is 90% cobbles at base.

6/16/00

14:25 stake hole



EP-7

14:55 Bag samples:

EP-5 (8') U-03-52-28
EP-6 (3') U-03-52-29

15:35 Curtis takes samples and leaves site.

I will restake all remaining test pits (which have been completed but not restaked.)

15:45 restaked G2-2 (NW corner of pit)
15:55 Attempted to restring barbed wire on diversion trench, was unsuccessful.

6/16/00

16:10 Restake G1-2 (SE corner of pit 2.

16:16 Restake G1-1 (SW corner)

16:25 Restake G3-2 (NE corner)
16:30 Restake G3-3 (SE corner)
16:40 Restake G3-4 (NE corner)
16:50 leave site

6/20/00

7:00 Arrive on-site, weather is sunny, but rain fell last night. No seepage was noted at the headwall or culvert last week or today. Drainfield has been dug. I will walk the excavation after transferring ~~data~~ equipment from Curtis truck.

7:20 Equipment transferred. Walk stockpile G-4 to locate test pit G4-1. Pam is backhoe operator, she will be available to begin digging after she finishes a task in the drainfield.

G4 is cut to bedrock at eastern side. Looks like some of the eastern side of the disturbed area ~~was~~ a borrow for the western side. Stream cut below G4 shows bedrock as pink/green granite and red siliceous dike rock.

6/20/00

7:45 Charlie says that the drain field trench is too deep to enter. I'll walk it at the surface. At old drainage, a sand layer was encountered down to 15' bls then backfilled to level with the rest of the trench. Sand is grayish brown

★ no discoloration or precipitates

7:55 - logging trench, begin @ headwall ≈ 3'-4' of mixed sediment and waste rock at headwall above sand layer with roots. Above root zone layering is black and orange in matrix. Moving upstream to sand layer of old channel, 3' of brownish GC with little waste rock apparent. Upgradient of sand channel, trench shows bedrock as granitic (pink/green)?, with 2'-3' of sand/mud with roots above, overlain by 1'-2' of red/yellow/brown stained rock/soil,

→

JR
6/20/00

(cont) overlain by about 6"-1' of crushed limestone mixed with unknown black matrix and covered on surfaces with clear crystals up to ½ in long (gypsum?). This black upper interval is well cemented and could be a road fill? Collected a sample for later examination.

8:30 Met with Pam for H&S meeting & explanation of backhoe needs. She moved to 64 to dig. Gear up for sampling.

9:00 Begin Pit 64-1. This area does not look like it has much more than a veneer of waste rock, if any.

9:05 Root zone is 1½' of dark brown blocky soil, roots extant to several (up to 5") inches into underlying yellowish material underlying.

6/20/00
JR

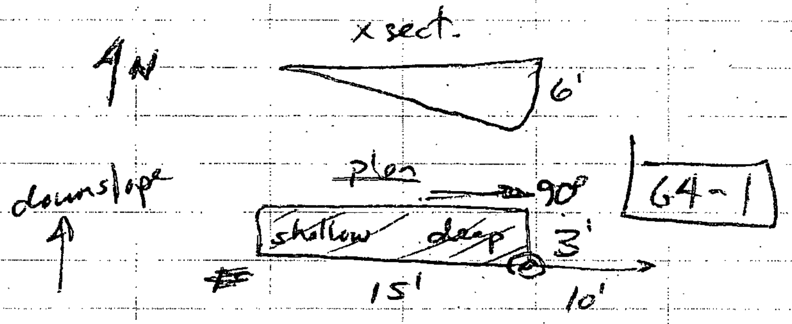
roots are dense vegetation is dense and healthy.

9:15 Sampled from pit wall with clean scoop (stainless steel) at 2' below soil interface. Material description: Sc, 10% cobbles/boulders. 90% gravelly sand with clays, yellowish (10YR 7/4), slightly moist, moderate plasticity — weathered granite. Cobbles are siliceous dike rock, white with disseminated fine pyrite x-tals.

9:25 Sample 4' depth from wall of pit as above. Same material — weathered ~~bed~~ granite. At 5', there is a layer of cobbles, angular ≤ 3"-4" diam., cobbles are tuff, glassy and powdery textures, plus minor cherty dike rocks. Bedrock is at 6' with thin brown soil layer on top (roots present.)

6/20/00

9:40 Pam is trying to scrape a sample of soil of the bedrock contact.



9:45 Collect 6' sample of old topsoil surface. Sample is slightly mixed w/slough, but fairly clean, dark brown to reddish brown, roots present, gypsum (?) xtals on clod surfaces frequent, moist sandy clay (SC) with occasional cobbles of weathered tuff.

10:00 Sketch pit + photo
10:05 Fill in pit G4-1

JP 6/20/00

10:06 Composite samples for pit G4-1 as follows:

U-03-52-30	2' and 4' composite yellow weathered granite
U-03-52-31	6' old topsoil

10:25 Resurvey stake to SE corner of pit.

11:00 Spent several minutes examining cut through road near headwall and trench near monitoring well. Pam is digging EP-8 at west edge of G4.

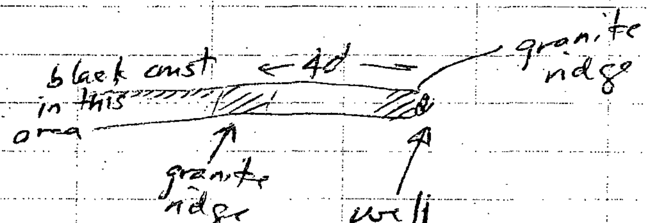
Notes on road cut at headwall

Material under road and in down-gradient portion of trench are similar with bedrock (granitic) ≈ 3'-5' of fill over mixed waste layer 1'-2' thick and black crust layer (old road) w/ limestone chips (1-2'). Road fill above old road is ≈ 2' thick (waste rock)

6/20/00

11:05 Notes on trench near ~~old~~ monitoring well:

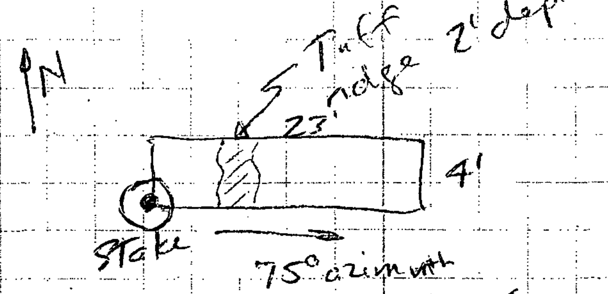
Trench for drain field ends to the south at monitoring well. About 40 feet to the north of the well is a ridge of bedrock in trench. Black crust unit pinches out from north at the bdrock ridge. ≈3' of alluvial material on bedrock overlain by 8' of mixed yellowish wasterock and lenses of limestone cobbles.

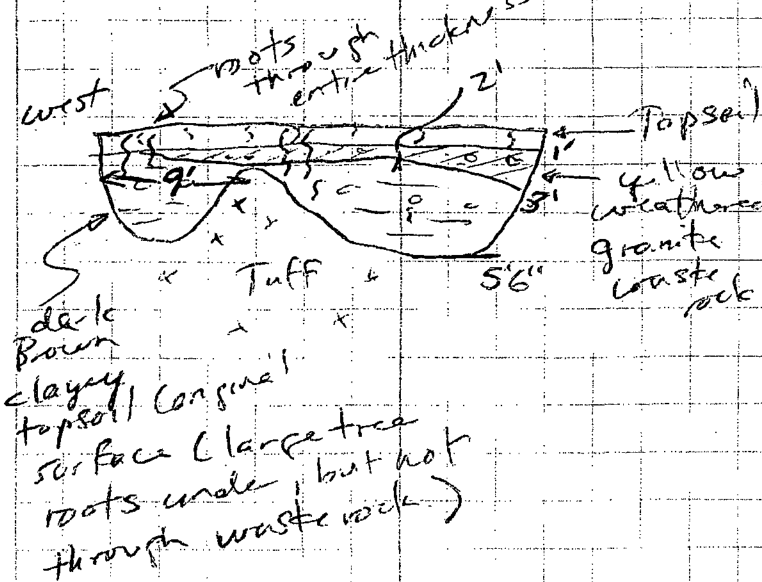


Toe of G3 seems to pinch out between bedrock ridge and well. upstream of well, wasterock, (yellow, pink matrix, limestone granite, and pyritic material) are in channel bed.

6/20/00

11:12 Pit EP-8



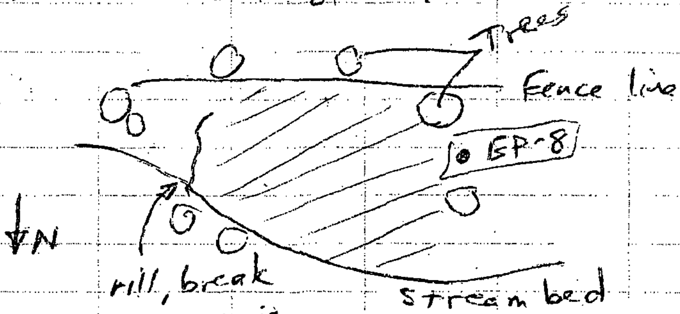


Roots extend through some but not all waste rock, depending on how well mixed.

JP
6/20/00

1

11:35 Extent of G4

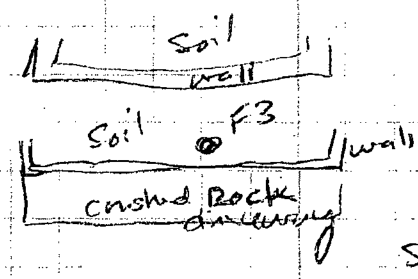


12:15 Took awhile to get the backhoe out of G4 due to the cutoff wall pit. Now at F3 on residential hillside.

12:20 Begin digging F3
Sample @ 2'
Material description – topsoil to 2' ~~dark~~ brown, clayey sand with roots into conglomerate pea-gravel fill underlying. 2' sample is mixed. Sampled

6/20/00
JD

(cont) at 3' depth. Material is same pea gravel material found under north end of pile G1. Sometimes looks like weathered tuff, but has rounded gravel (up to 1/2").



Low plastic matrix, mud-stone cobbles, moist, firm

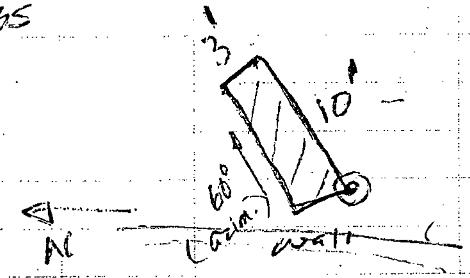
12:50 Sample at 5'
Same as above, but occasional boulders up to 2' diam of tuff and occasional chips of limestone.
* note driveway material is primarily limestone cobbles.

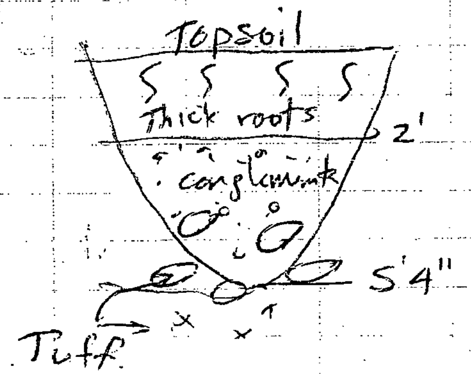
12:55 Hit bedrock @ 5'4" (tuff)
13:00 Dug 2' into adjacent driveway, no conglomerate. Quartz vein rock w/no pyrite, tuff, and 75% limestone cobbles.

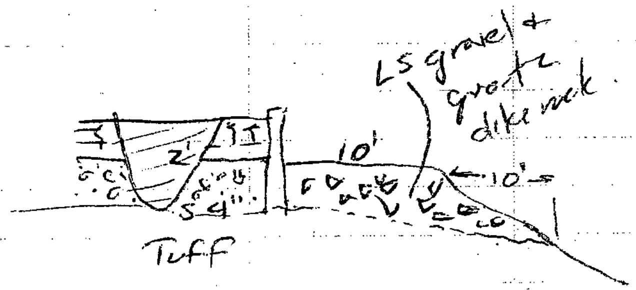
6/20/00
JP

13:05

Pit F3



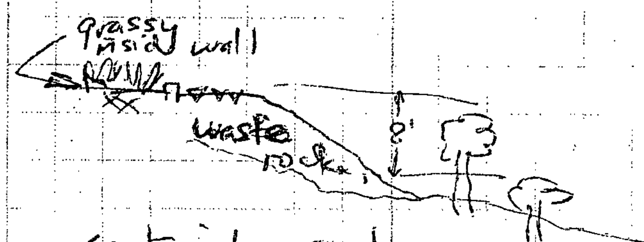




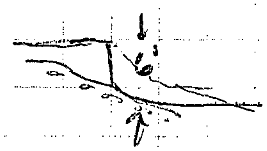
13:30 composite 2' and 4' subsamples into $\boxed{\text{U-03-S2-32}}$

6/20/00
JP

14:10 Walked area of residential foundations. Most driveways are of mixed quartz and limestone cobbles as at F3. Only the large road to ~~large~~ "mine manager's house" is composed of mineralized waste rock with dark dike rock w/pyrite xtals + orange + yellow staining in soil matrix. Locate F2 on driveway in front of foundation on use backhoe to dig at side of road (Photo).



Cut into road



Bedrock is weathered tuff or fine grained granitic rock, could not get a fresh surface.

6/20/00
JR

14:30 Discuss status with Curtis. He will have to show me out the other gate due to trench across road.

14:40 Material description at cut in Road (F2) near "mine Mgrs" house:
GM – Cobble matrix with clay lenses (dark brown) Cobbles/boulders (up to 6") are primarily granitic greenish and dark porphyries w/ pink feldspar or pyrite phenocrysts. Sand fraction is stained orange between cobbles.

15:00 Sample composite from 2' depth to 5' depth using hands and bucket collecting "channel chip" from pit wall. $\boxed{\text{U-03-52-33}}$
(F2)

15:15 Drive to guardshack with Curtis to check in.

6/20/00
JR

16:00 Discussion with Curtis on work left to do, what we've learned. Unanswered question still is seepage flow paths. None have been identified, but rills on faces of G3 and G1 seem to show solutions impacting matrix by staining and cementing.

16:05 Walk the rest of the residential area to measure amt. of rock fill, using old 1979 aerial to locate all foundations.

16:45 Finish sketching (on separate sheet) the foundation areas. No actual house footprint seems to be underlain by waste rock. All roads constructed with rock were paced off and thicknesses estimated.

16:47 Stake Pit F2.

17:00 Leave site.

6/21/00

7:10 Arrive on site, ~~move~~ excavator to location of EP-9, near concrete pad in "suspect materials" area between G2 and G3.

7:30 Begin digging EP-9. Examine pit walls at ≈ 4' deep. Soil cover is 1" to 12" with grass growing even on thin surface. Soil underlain by layer of crushed limestone (from powder to 6" cobbles), layer is 2" to 8", roots extent through limestone into wasterock up to 4".

Underlying waste rock is yellowish GC w/ 30% cobbles/blds. and lenses of more clayey material. Cobbles are greenish granitic and (white) quartz or dark gray porphyry with pyrite phenocrysts + other accessory mineralization. No limestone cobbles in wasterock. Clay matrix has orange and red mineralization (hematite, jarosite).

6/21/00

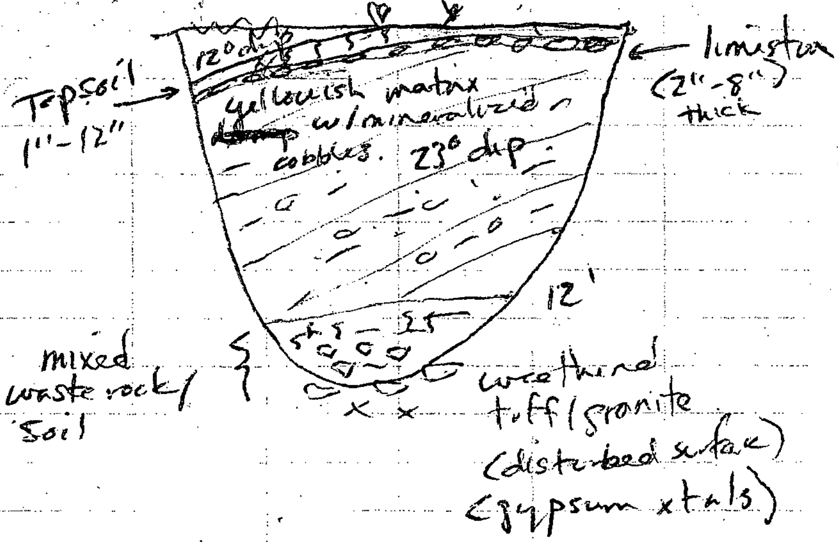
7:40-7:55 Delay to refuel excavator. Charlie says I can use excavator for this hole and one more, then he needs it for another job. He talked about sending it out of town. He and Curtis are discussing "Lampbright".

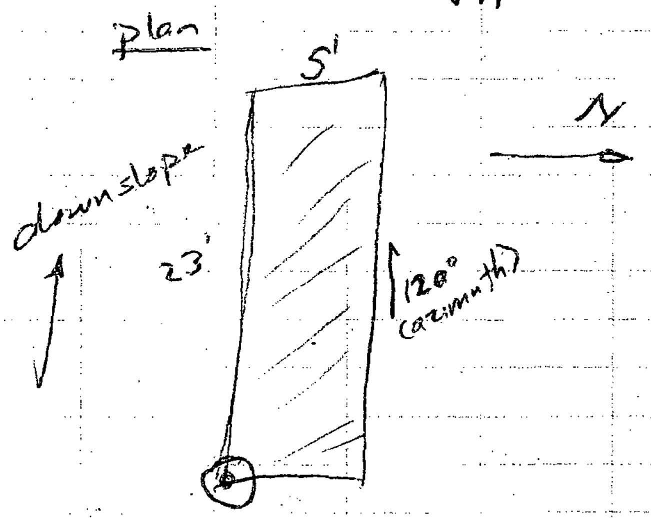
8:00 Continue digging EP-9. Yellowish rock to 12', then hit brownish clayey soil with roots and free water. No water in hole, but sandy lenses in underlying soil is saturated.

8:20 Bedrock at 15' - weathered tuff cobbles and fine grained granitic (greenish w/feldspars weath to clays) came up in bucket. Interval of 12' to 15' is mixed waste rock + soil w/ lumber pieces + nails. Free water is only in the dark brown sandy soil w/roots. No water in hole.

6/21/00
JR

8:45 Sketch EP-9 x-sect





8:50 Filled in hole EP-9 + staked at southeast corner.

6/21/00
JR

note: 59 loads x (12 yds/load) new material on G3 NE hillside from drainfield.

9:20 Dig R-1 in Road west of G2. Will collect a geotech. sample from this hole 40' from pipeline stakes.

9:25 Sample @ 2' depth. material description: gray GC, 80% cobbles/boulders. Matrix is gravelly sand with clay. Cobbles are primarily limestone, some with pyrite xtals, few granite rocks with greenish weathered feldspar xtals. Slightly moist (thin crust (≈2") of crushed granite on road surface)

9:32 Sample @ 4' depth. Same as above, a few ~~mud~~ silt stone cobbles identified.

9:39 Sample @ 6' depth. Some orange staining of soil matrix and cobble rinds. Otherwise same as above.

6/21/00
SP

9:52 Sample R-1 @ 8' depth
material description:
Texturally identical to above
but moist and only 50%
limestone cobbles. Other
cobbles are granitic (greenish
fine grained) and siltstone,
vien rock with mineralization.
Change in color to dark brown

10:04 Sample @ 10' depth.
continues to grade downwards
to more mineralized cobbles
and less limestone. Copper
hydroxides and iron cemented
aggregates present.
★ note – sequence is similar to
G3-4 and G3-3.

10:15 Sample @ 12' – this interval
is identical to the 2' depth.
but moist, with old fabric,
glass, and wood.
Collect Geotech Sample
R-1-12'

6/21/00
SP

cont- pipeline is ≈40' to east and
about 4' above this sample depth.

★ Notes: Entire hole is loose
material, but w/ cemented
aggregates w/cement that fizzes
w/~~HCL~~. Matrix has strong
reaction w/HCL on all sub samples.

10:45 Sample @ 14' depth.
Same as 10' depth; but
very moist; gypsum xtals
on same weathered surfaces.

10:55 Sample @ 16' – same as
above, weak fizz w/HCL,
thicker iron ~~coat~~ oxide coatings
on cobbles.

11:03 Sample @ 18' depth.
dark brown interbedded
SM and MH. No cobbles,
Looks like channel deposits.
Branches present. Material is
very moist to saturated in the
silts and clays, no fizz w/HCL,
Some waste rock cobbles mixed (lime-
stone, granitic, tuff, vien rock.

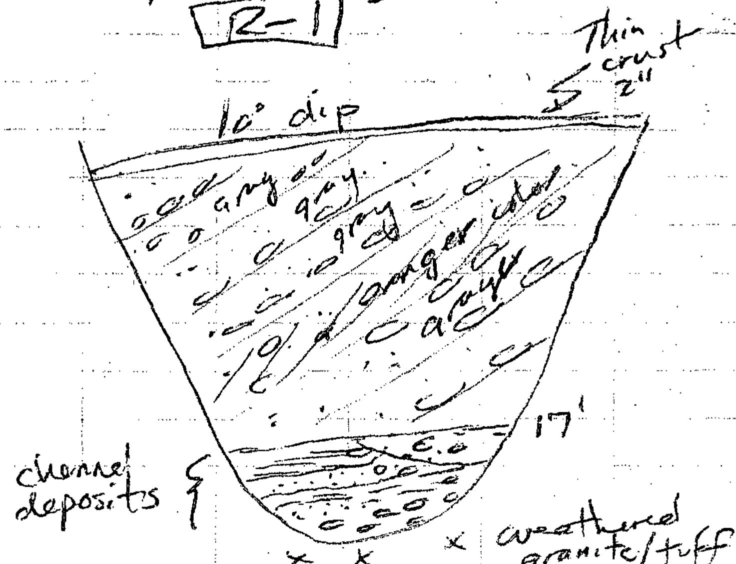
6/21/00

11:25 Sample @ 20' depth.
dark brown globules of clayey
soil with roots mixed with
waste rock (may be slough) and
weathered tuff cobbles.
Sand present in layers, very
wet - saturated.)

11:30
Sample @ 22' depth - same as
above - more sand layers,
less clay

11:35 Hit bedrock @ 23', weathered
tuff a fine grained granitic
(pink/green).

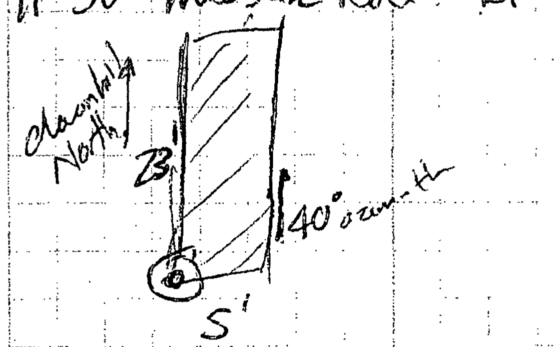
R-1



6/21/00

R-1

11:50 Measure hole. R1



12:00 Charlie shows up and needs
to get George and the excavator
back to the drain field. We
will send Pam over to the E1
site when George is done
filling. R-1

12:10 After some thought, I've
decided to composite all
waste rock to one sample
(2'-16') because the beds as
seen in the pit wall are dipping
45° so that depth intervals
collected with backhoe are mixing
the beds, and also because the
beds are very similar with
more or less iron oxide staining.

6/21/00
JP

(continued). There are no discrete beds which seem to be "source" material, and limestone is present in all beds, including deeper beds. 18' and 20' samples will be ~~composite~~ discretely sampled, and the 20' sample held for analysis in the case that the 18' sample (original surface) is impacted.

12:18 ~~bag~~ and composite samples.

U-03-52-34	2'-16' (WR)
U-03-52-35	18' (soil)
U-03-52-36	20' (soil)

12:35 Pam is waiting to dig at F1. I have composite U-03-52-34 + bagged. I will keep the other two F1 samples in truck + bag later.

12:36 stake R-1, and move to F1

6/21/00
JP

12:50 locate F1 on NW ~~edge~~ corner of loading ramp as shown on map. The south side is closed off due to shaft and the backhoe cannot get onto ramp without building a dirt ramp. We will dig at exposed corner of foundations

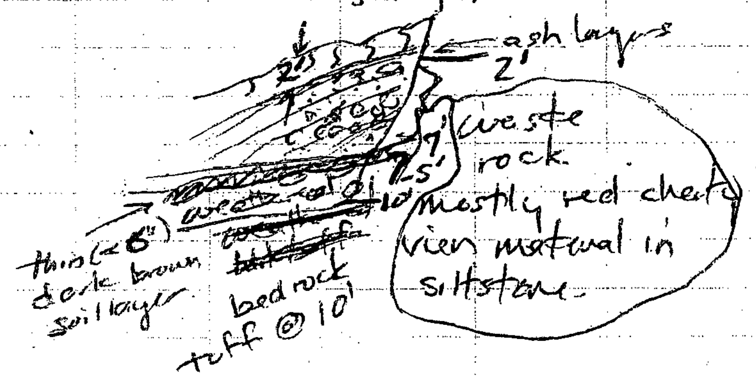
Photo

12:54 Begin digging F1.
Root zone is up to 2'6", although topsoil is only 8"-18". Layers of ash from incinerator (?) seem to be related to depth of roots. (22° dip on surface & ash beds)

Waste rock underlying soil cover is GC as seen in pile G3 on NE hillside, but no thick weathering rinds and yellow clays. Cobbles on red chert viens in siltstone. No mineralization noted in cobbles. Cobbles/boulders 40% in reddish brown sandy gravel matrix

6/21/00

13:20 Sample F1 from pit wall, channel chip with hands into bucket from 2' depth to 4' depth. Matrix is slightly moist



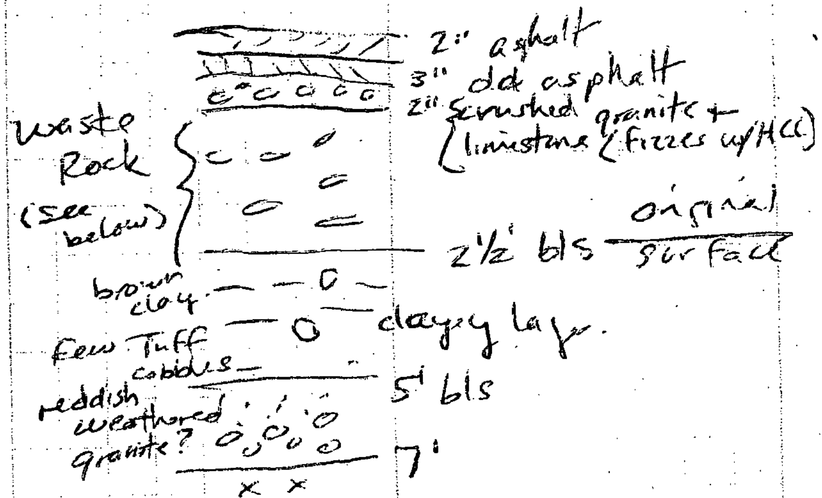
13:30 Bag 2'-4' composite sample from F1. Pam leaves & George takes over digging to confirm bedrock contact at 7.5'

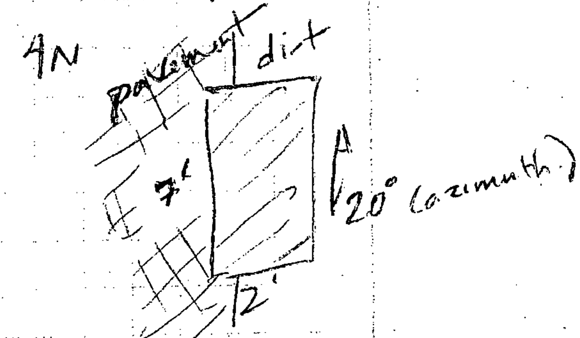
| U-03-52-37 | 2'-4' composite

13:58 George moves to dig R3 near "mine Mgrs" house on paved road. leaves hole open (≈3').

6/21/00

14:15 Move to R2 & begin digging.





15:00 Waste rock is GC, 70% cobbles/boulders, matrix is yellowish stained gravelly sand w/ clay, no fizz, slightly moist. Cobbles are granitic and grayish porphyry with pyrite xtals. (sampled in pit from 1'-2' bls)

6/21/00
JP

15:05 brown clay layer underlying waste rock had occasional cobbles/gravel of tuff. Under clay is reddish weathered fine grained granitic or tuff bedrock in sandy matrix, no plasticity, slightly moist.

Sampled clay layer from wall of pit at 3'.

15:15 Bag samples as follows.

$\boxed{\text{R1-03-52-38}}$	1'-2' composite
$\boxed{\text{R1-03-52-39}}$	3' underlying clay.

15:35 Finished with R2 samples. Bag samples from R1 (18', 20') to catch up.

16:00 Move back to R3 to log and sample. Note that both R2 and R3 are on paved roads. R2 was sampled from beneath asphalt. R3 is at the pavement edge, so that samples are collected from 4' offset of pavement.

6/21/00
JP

16:15 logging pit R3 wall

waste rocks, —— 2" asphalt

(note below)

1' bls

mixed (disturbed?) soil layers and cobbley lenses of tuff and granitic bedrock material

dry —— 3' bls —— Roots present

Fractured bedrock fine grained granitic greenish, dry highly fractured, roots present

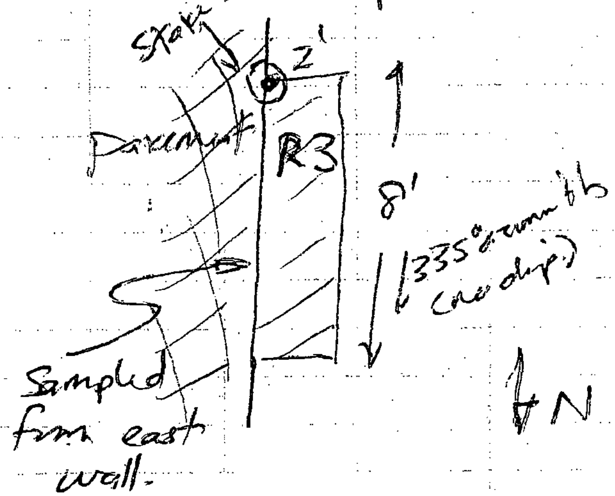
4 1/2' competent bedrock

1' thick yellowish layer under asphalt is well cemented (firm), dry, low plasticity GM. Cobbles/Boulders (10%) are quartz vien rock (as seen near the glory hole) and white quartz granite. No mineralization in cobbles or gravel, no limestone. Matrix is light brown to yellowish brown sand with fines, no reaction to HCL.

6/21/00
JP

16:35 Sample 3"-1' Road bed material and soil layer at 2' depth.

Note that yellowish road bed material doesn't occur on west side of pit, only ~~at~~ under pavement.



* Note also that samples had to be hammered out of pit wall with rock hammer. ~~(1'-1')~~

6/21/00
JP

16:55 Bag samples

U-03-52-40	- 3"-1' interval
U-03-52-41	- 2' (soil)

17:10 Leave site

6/22/00

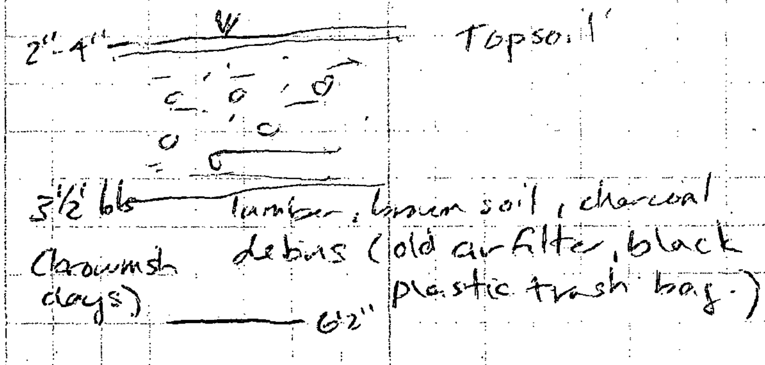
7:15 Arrive on-site, weather is sunny + clear. No seepage has been noted at the headwall or culvert during fieldwork.
George is filling in R3

7:30 Begin digging EP-10 Near toe of "suspect materials, just east of tailings pipeline to estimate material type, thickness, and collect geotech sample.

7:40 Soil cover (EP-10) is 2"-4" thick with roots extending to 1" below (into wasterock) Mining materials below topsoil is GC, 30% cobbles/boulders (50% limestone, 50% Tuff, dark gray porphyry with pyrite + chalcopyrite mineralization, and gray dike rock with no mineralization). Matrix is gravelly sand with clay, plastic, slightly moist, light brown. Fizzes strongly w/ HCl.

6/22/00

EP-10



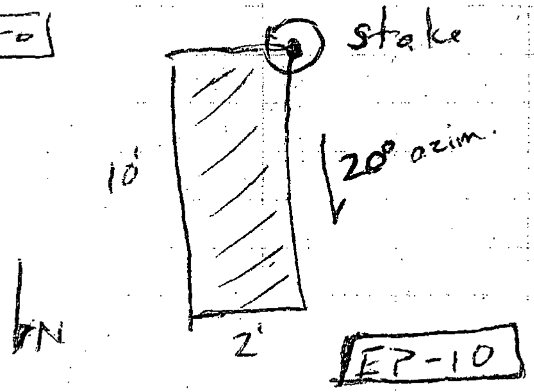
8:05 George left at 7:55 to move excavator off site. This hole (EP-10) is not deep enough to collect geotech sample. Pipeline is about 25' to west at approx. same elevation as the old surface in pit. However, I've decided to sample material for ABA and metals to characterize sediments above surface (old). Sample collected from spoils pile representative of about 3' depth. u-03-52-42

JP 6/22/00

8:30 George is not yet back from moving excavator. Phil Harrigan w/NMED arrived about 15 minutes ago and we discussed overall preliminary findings.

8:35 George returns, continue digging EP-10. Layer of debris below 3½' contains cobbles of tuff, limestone (50%) granitic (pink/green), and some mineralized gray porphyry. Debris continues to bedrock or weathered bedrock of tuff (> 2' boulders). Did not sample underlying material. Bedrock (refusal) at 6'2".

photo



6/22/00
JP

9:05 Phil leaves to go watch liner installation at drainfield. George fills in hole EP-10.

9:20 Backhoe has a broken tooth. welder just arrived to fix it. Estimates ½ hour of work. I'll walk the G3 area uphill.

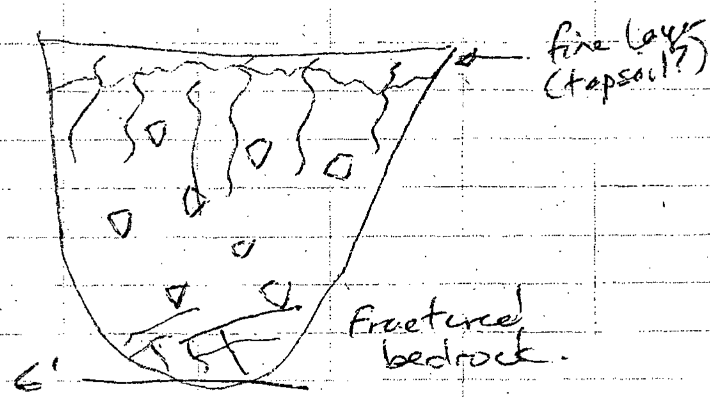
9:45 Upper area of G3 is well defined by drainage ditch, except near the San Jose shaft where a small amount of waste rock extends uphill in a clearing which should easy to delineate on aerial photo. The uphill area is disturbed but no stockpiles were identified, bedrock crops out, making it easy to determine source of float on surface.

10:10 Finished walking G3 perimeter uphill. Made notes on map. George just moved to R4.

6/22/00
JP

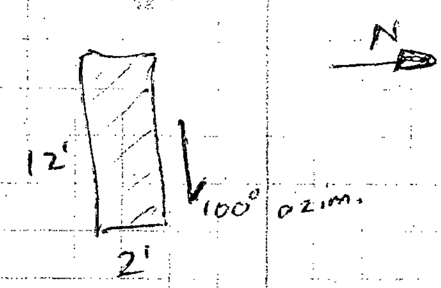
10:15 Sample (R4) at 2' depth
material description: ~~weathered~~
Fractured granite (pink/green
fine grained as seen on
the hill above road and in
rill adjacent to south)
GM, grayish brown, 80% cobbles
angular, matrix of gravelly
sand with silt.
★ roots to 3', ~~no~~ topsoil (?)
is irregular, may be same
material as matrix above.

10:28 Sample at 4' - same as above.



JP
6/22/00

R4



10:40 6' sample is broken bedrock
(granitic) gravel to > 4",
no matrix. Not sampled.
Stop digging.

10:50 Composite 2' and 4' Samples
U-03-52-43 R4

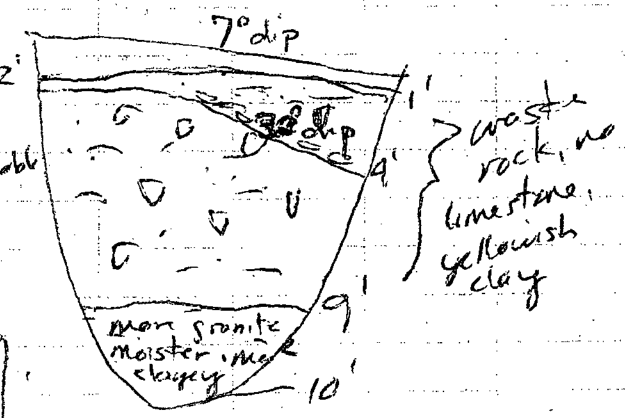
11:10 Begin digging EP-11 near
toe of 63 Hwy pipeline to
collect Geotech sample.
Topsoil 1'-2', roots extend
several inches into wasterock.
Material under topsoil is
GC, yellowish, moist, 30%
Cobbles/boulders primarily porphyry
+ granitic, pyrite mineralization in
porphyry, thick yellow clay rind on
cobbles & gypsum xtals throughout.

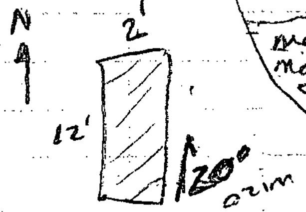
6/22/00

11:40 Down to 7' in EP-11.
Same material throughout,
~~little~~ little limestone present, no fizz
on matrix.

11:45 9½' - collected Geotech Sample
~~EP~~ $\boxed{EP-11-9.5}$
at 9' material becomes more
moist (very moist) and highly
weathered. Rocks are moldable
with hands, esp. granitic cobbles.
Pyrite and other minerals are
common in clays.

12:00 Maxed out reach of backhoe
at 10'.





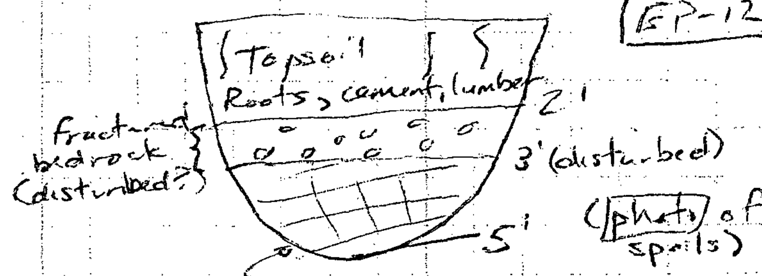
6/22/00

12:15 Fill in and stake hole EP-11

12:30 Begin digging EP-12 at
Northern toe of GZ next
to old cement foundation.

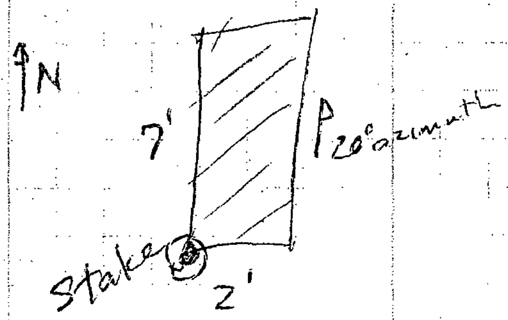
No Waste Rock

$\boxed{EP-12}$



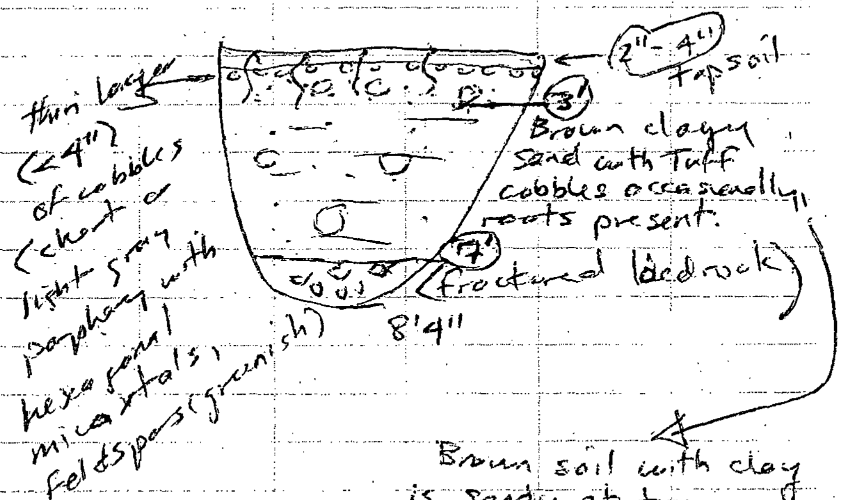
(photo of spoils)

~~weathered~~ granitic (fine grained)
intact, but highly fractured



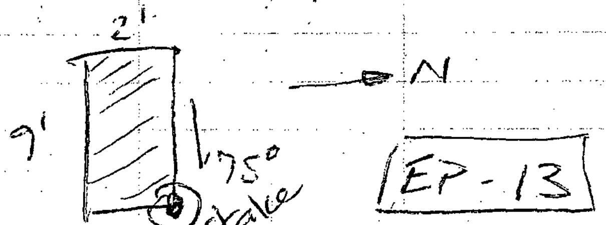
6/22/00

13:00 Begin digging EP-13 NE of EP-12 near wooden crossing on rill. No waste rock.



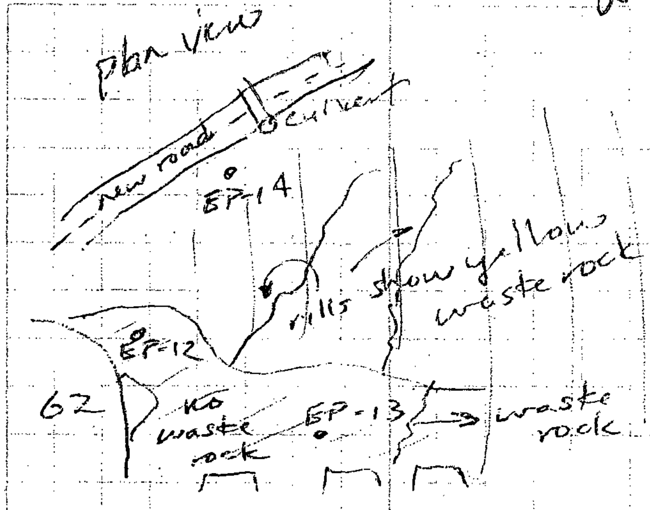
Brown soil with clay is sandy at top, grading down to clay. Sand soil fizzes w/HCl although no ls cobbles were identified.

13:15 stopped digging at 8'4" in fractured granite.



EP-13

6/22/00

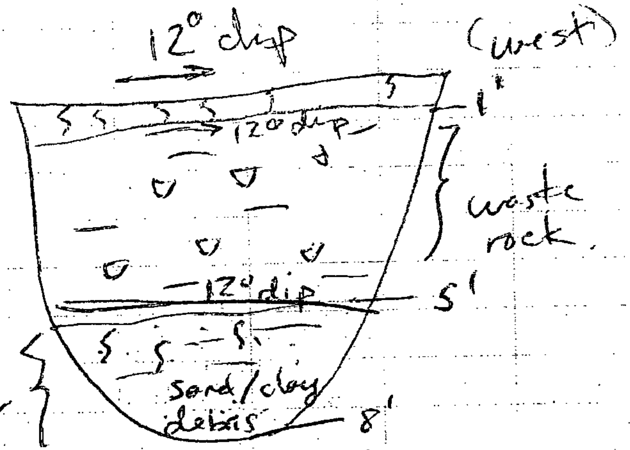


13:35 Start digging EP-14 near culvert at berm of new road in "suspect materials area". Topsoil is covered with thin film of sediment from being at upgradient end of culvert. top soil ≈1' thick with roots extending to 2" or 3" below base of soil into waste rock.

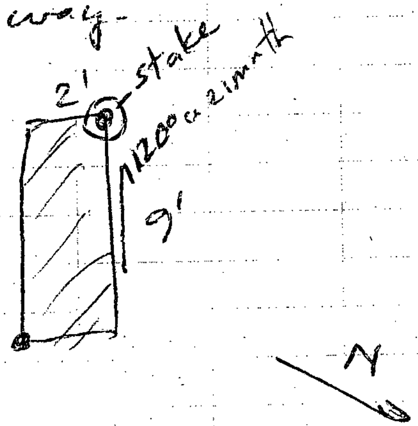
13:45 waste rock identical to that seen in EP-9 to the east. (No limestone, mineralized porphories, granite, and yellow clay)

6/22/00
JR

13:55



Working surface, lumber, piping, cement, dark brown sand soil and clay with roots. Stopped at 8' due to cement in the way.



6/22/00
JR

14:00 Surveyors from Engineers, Inc arrive.

16:00 Showed surveyors around the site + explained seepe. We added the spillway, drainfield, pipeline pts, and vegetation survey transects to seepe. Curtis and transferred equipment to his truck and discussed fieldwork.

16:05 Leave site

APPENDIX C

TEST PIT LOGS

FIELD TEST PIT LOG

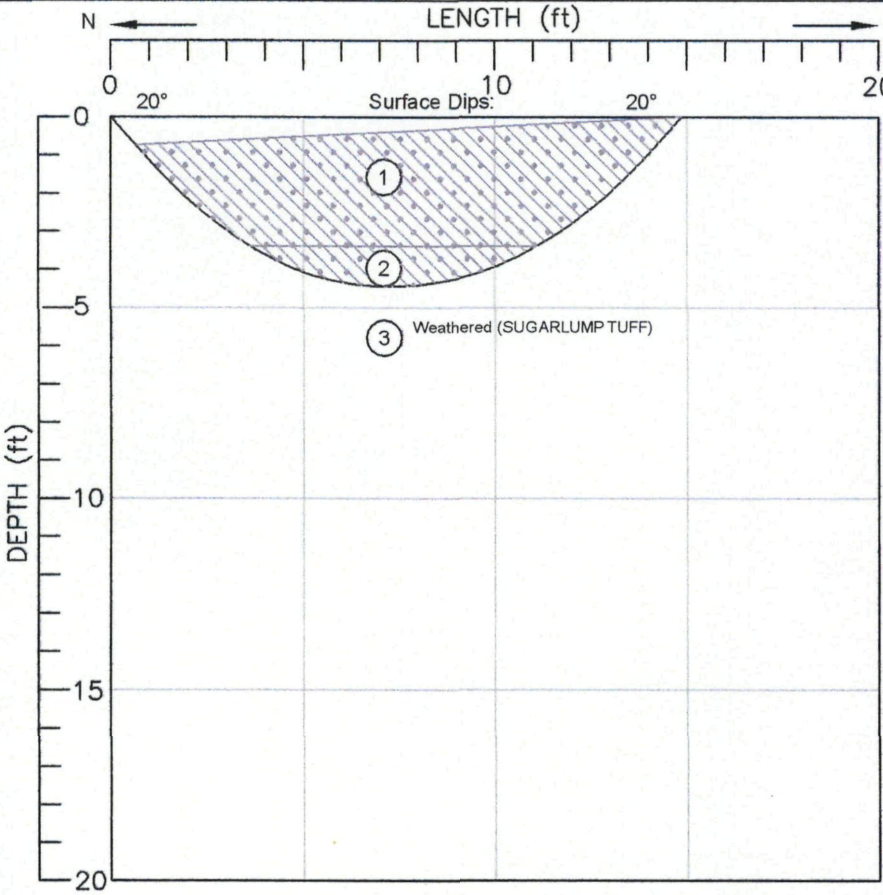
TEST PIT G1-1

TEMP ____°F WEATHER ________ ENGINEER Jen Pepe OPERATOR G. Shepard

EQUIPMENT 235 Cat Excavator CONTRACTOR James Hamilton Construction DATE 6/15/00

ELEVATION 6106.3 DATUM ________ JOB 003-2562

LOCATION Groundhog Mine, New Mexico

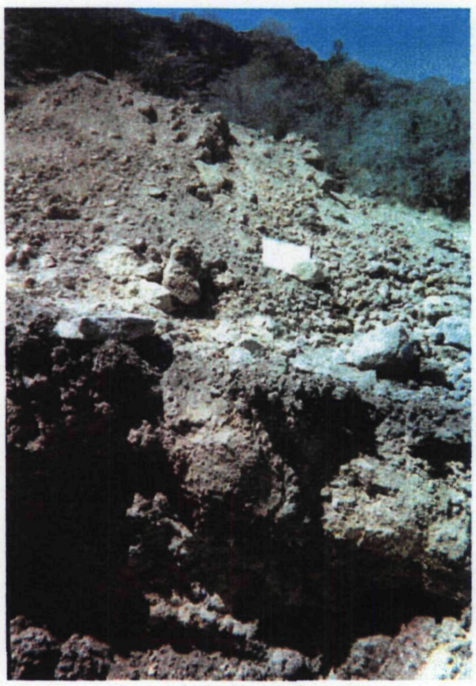


ROOT ZONE DESCRIPTIONS

Roots extend 4" to 12" to base of cover soil. Vegetation sparse.

LITHOLOGIC DESCRIPTIONS

1. (1'-3.5') (GC) Clayey gravel with sand, reddish to yellowish, 30%>1.5" (average 5", max 2.5'), primarily quartz/feldspar granite and porphyry with disseminated pyrite, bornite, and accessory minerals, some tuff cobbles. Highly plastic, thick clay rinds on weathered granite. Clays stained yellow with orange precipitates locally. Slight sulfur smell. Moist. (STOCKPILE MATERIALS)
2. (3.5'-4.5') (GC) Gravelly and with clay, dark brown to pinkish yellow, 30%>1.5", primarily weathered tuff, few siliceous cobbles. Highly weathered, cobbles break apart with hand or mold into plastic clay, thick soft weathering rinds on cobbles. Sample is mixed original surface, including thin soil layer, and highly weathered parent material. (STOCKPILE MATERIALS)
3. Weathered bedrock (SUGARLUMP TUFF).



SAMPLES

NO.	DESCRIPTION
u-03-52-24	2'
u-03-52-25	4' (original surface)

SPECIAL NOTES:

1) No groundwater encountered.
2) Test pit backfilled with excavated mineral.
3) Pit excavated parallel to the slope.
4) Refusal met at 4.5'.

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FIELD TEST PIT LOG

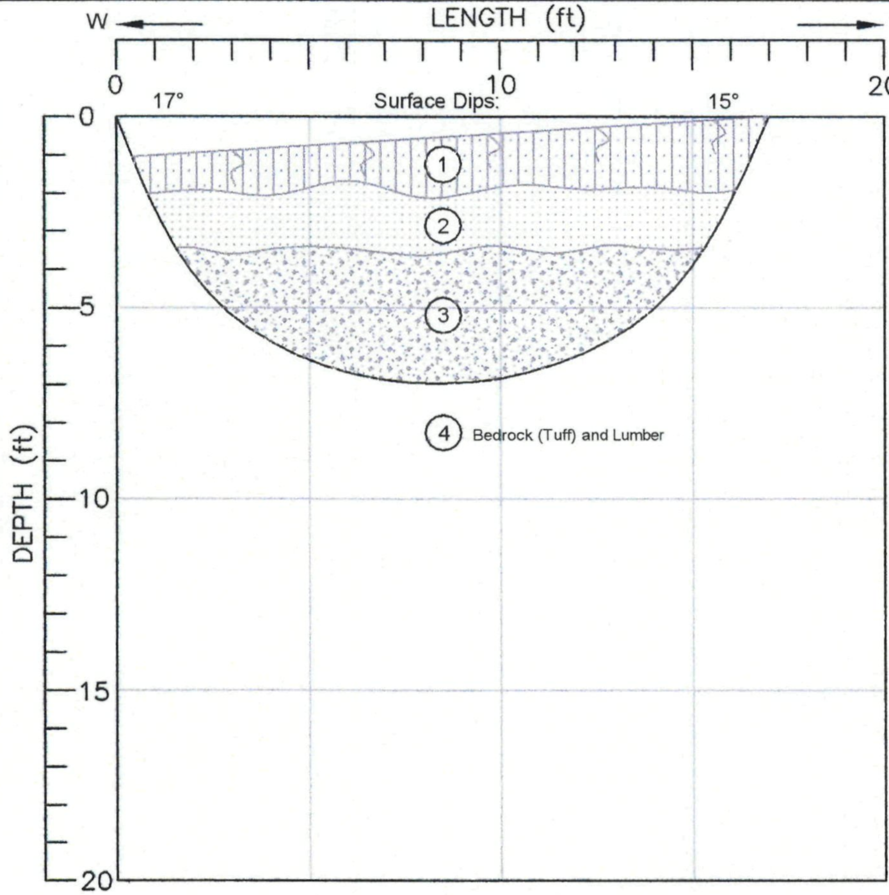
TEST PIT G1-2

TEMP ____°F WEATHER ____ ENGINEER Jen Pepe OPERATOR G. Shepard

EQUIPMENT 235 Cat Excavator CONTRACTOR James Hamilton Construction DATE 6/15/00

ELEVATION 6121.0 DATUM ____ JOB 003-2562

LOCATION Groundhog Mine, New Mexico



ROOT ZONE DESCRIPTIONS

Cover soil 1'4" to 2' thick. Roots extend up to 3" into the stockpile materials beneath cover soil. Tuff cobbles present in cover soil.

LITHOLOGIC DESCRIPTIONS

1) (0'-2') (SM) Light to dark brown gravelly sand with fines, slightly moist to moist, reacts with HCl. (COVER SOIL).

2) (2'-3.5') (SP) Poorly graded gravelly sand with clay weathered from feldspars, some quartz grains in clay. Stockpile material is yellowish (2.5 YR 8/4), moist. Light gray limestone cobbles mixed 4" into top of yellowish stockpile material, some aggregates cemented very hard with lime. Slight sulfur smell, moist. (STOCKPILE MATERIAL).

3) (3.5'-7') (GW) Well graded gravel with sand and minor clay, light brownish gray to yellowish gray, 60%>1.5", primarily limestone with some tuff and minor mudstone and mineralized quartz vein rock with pyrite, chalcopyrite, and galina. Moist, moderate plasticity, reacts with HCl. Few dark brown cemented clayey lenses with minor secondary gypsum crystals. Lumber at base of interval. (STOCKPILE MATERIAL)

4) Bedrock (SUGARLUMP TUFF).

SAMPLES

NO.	DESCRIPTION
u-03-52-21	2' (mixed limestone and yellowish sand)
u-03-52-22	4'
u-03-52-23	6'

SPECIAL NOTES:

1) No groundwater encountered.
2) Test pit backfilled with excavated mineral.
3) Refusal met at 7'.

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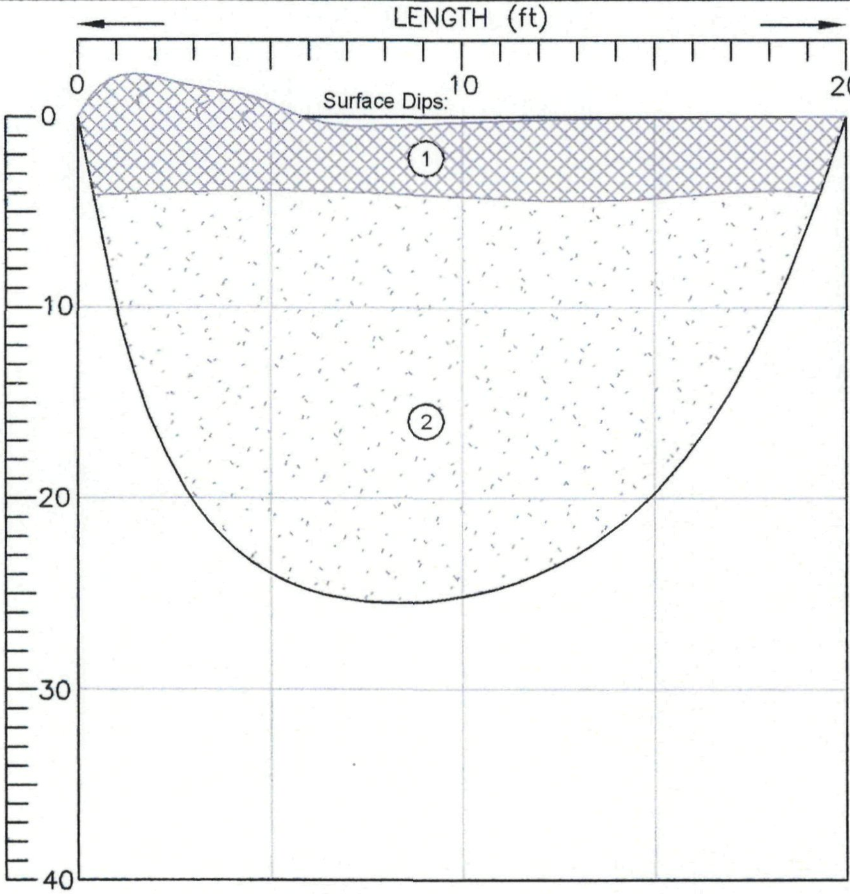
FIELD TEST PIT LOG

TEST PIT G1-3

TEMP ____ °F WEATHER ______
ENGINEER Jen Pepe
OPERATOR G. Shepard
EQUIPMENT 235 Cat Excavator
CONTRACTOR James Hamilton Construction
DATE 6/14/00
ELEVATION 6095.6
DATUM ______
JOB 003-2562
LOCATION Groundhog Mine, New Mexico



ROOT ZONE DESCRIPTIONS

Roots present in pit to 14'. Roots of grasses dense, extend up to 3.5' from surface.

LITHOLOGIC DESCRIPTIONS

1. (0'-4') Mixed light brown sand with gravel and dark brown clay lenses with dense roots. Gravelly sand is slightly moist, cobbles are quartz granitics and porphyry, mudstone, and tuff, and minor pink/green altered granite. Clay lenses are moist, highly plastic, with white and yellow staining/precipitates. (MIXED FILL)

2. (4'-24') (SW) Gravelly sand, yellowish brown (2.5 YR 7/3), fine sand to gravel less than 1" (occasional cobbles to 8"), subangular to subrounded. Lithics are mudstone, feldspar, mica, tuff, chert, and pink/green altered granite. Weakly to moderately cemented, some preferred orientation of clasts in irregular intervals, no discrete bedding. Possibly natural conglomerate (no stockpile materials identified in this interval). Generally moist, becoming wet with weathered clasts at base of interval. (CONGLOMERATE)

SAMPLES

NO.	DESCRIPTION
u-03-52-18	2' (disturbed metal)
u-03-52-19	4' (conglomerate)
u-03-52-20	6' (conglomerate hold)

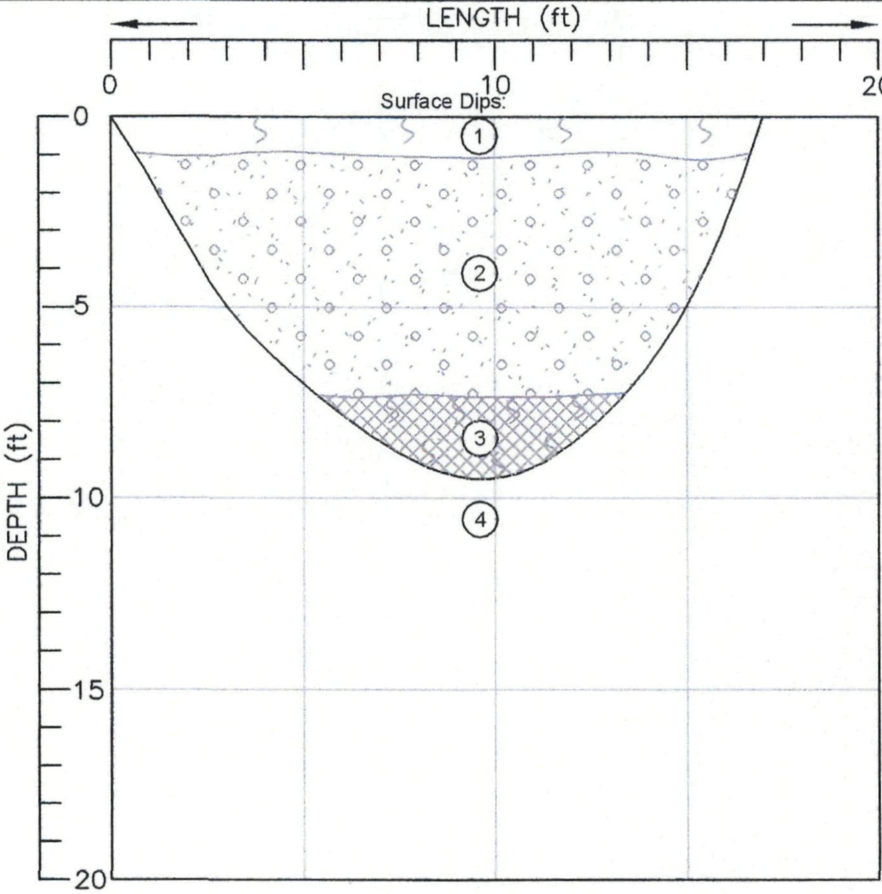
SPECIAL NOTES:

1) No groundwater encountered.
2) Test pit backfilled with excavated mineral.
3) Excavator reached exceeded at 24 feet.
4) 2' sample collected from wall of pit.

FIELD TEST PIT LOG

TEST PIT G2-1

TEMP ____ °F WEATHER	ENGINEER Jen Pepe	OPERATOR G. Shepard
EQUIPMENT 235 Cat Excavator	CONTRACTOR James Hamilton Construction	DATE 6/14/00
ELEVATION 6082.9	DATUM	JOB 003-2562
LOCATION Groundhog Mine, New Mexico		



ROOT ZONE DESCRIPTIONS

Cover soil 1'-18" thick, roots extend several inches into fill below cover soil.

LITHOLOGIC DESCRIPTIONS

1. (1'-1.5") (COVER SOIL).

2. (1'-7.5') (GW) Well graded gravel with sand, 20%>1.5", mixed rounded fine-grained tuff and angular glassy coarse-grained tuff, quartz granite and minor porphyry w/feldspar and pyrite phenocrysts. Some moderately cemented soil aggregates, but mostly loose, no plasticity, moist. Occasional lense of dark brown clay with roots and some yellow Fe oxide precipitates. (FILL)

3. (7.5'-9.5') Mixed fill (as above) and fractured bedrock (as below) with roots present. (MIXED FILL/COLORADO FORMATION).

4. Fractured siltstone, blocky, gray (2 YR 8/1) with red weathering rinds and veins (2 YR 6/8), up to 1'. Fine fraction slightly moist, reddish brown, no plasticity. (COLORADO FORMATION WITH QUARTZ VEINS).

SAMPLES

NO.	DESCRIPTION
u-03-52-16	2'- 6' comp.
u-03-52-17	8' underlying soil (root zone)

SPECIAL NOTES:

1) No groundwater encountered.
2) Test pit backfilled with excavated mineral.
3) Refusal met at 9.5'

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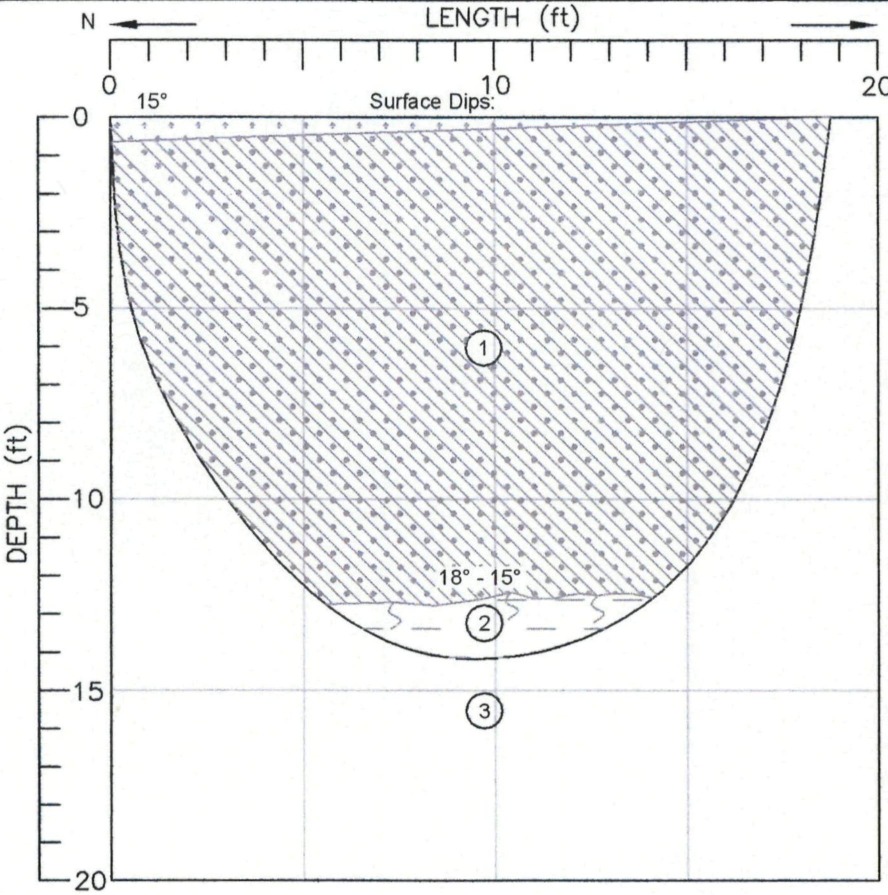
FIELD TEST PIT LOG

TEST PIT G2-2

TEMP ____ °F	WEATHER ____	
	ENGINEER Jen Pepe	OPERATOR G. Shepard
EQUIPMENT 235 Cat Excavator	CONTRACTOR James Hamilton Construction	DATE 6/14/00
ELEVATION 6077.9	DATUM ____	JOB 003-2562
LOCATION Groundhog Mine, New Mexico		



ROOT ZONE DESCRIPTIONS

No cover soil or vegetation at pit location.

LITHOLOGIC DESCRIPTIONS

1. (2'-12') (GC) Clayey gravel with sand, dark brown, 50%>1.5", up to 3' boulders, larger boulders are tuff, other lithics are fine to coarse grained pink and white granite, porphyry with pyrite phenocrysts, and minor small (<2") cobbles and gravel of chrysocolla. Thin veins of chrysocolla, galena, and associated minerals in porphyry cobbles. Moist to wet, highly plastic. Clay lenses with Fe oxides (jarosite, hematite) and blue Cu hydroxide precipitates. Thin clay weathering rinds on clasts. (STOCKPILE MATERIAL)
2. (12'-14') Mixed fractured bedrock (as below) and thin dark brown soil layers with roots. (MIXED SOIL HORIZON/COLORADO FORMATION).
3. Fractured siltstone, blocky, gray (2 YR 8/1) with red weathering rinds (2 YR 6/8), up to 1'. Fine fraction slightly moist, reddish brown, no plasticity. (COLORADO FORMATION WITH QUARTZ VEINS).

SAMPLES

NO.	DESCRIPTION
u-03-52-14	2'- 10' composite
u-03-52-15	14' bedrock

SPECIAL NOTES:

1) No groundwater encountered.
2) Test pit backfilled with excavated mineral.
3) Refusal met at 14'.

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FIELD TEST PIT LOG

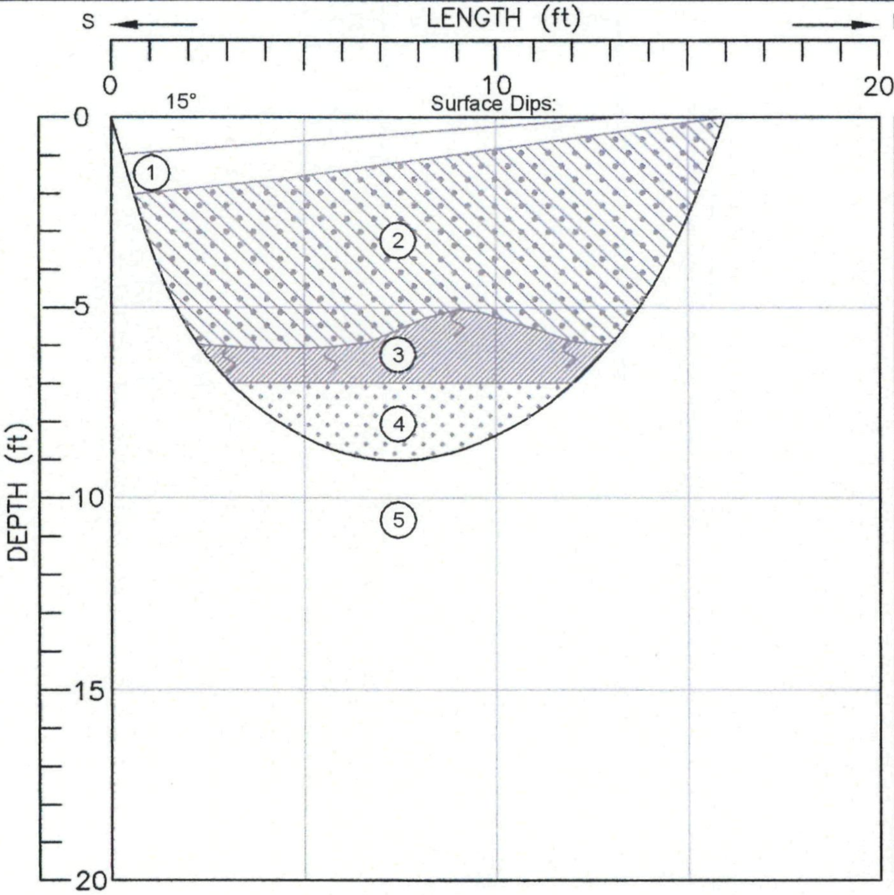
TEST PIT G3-1

TEMP ____°F WEATHER ________ ENGINEER Jen Pepe OPERATOR G. Shepard

EQUIPMENT 235 Cat Excavator CONTRACTOR James Hamilton Construction DATE 6/13/00

ELEVATION 6080.9 DATUM ________ JOB 003-2562

LOCATION Groundhog Mine, New Mexico

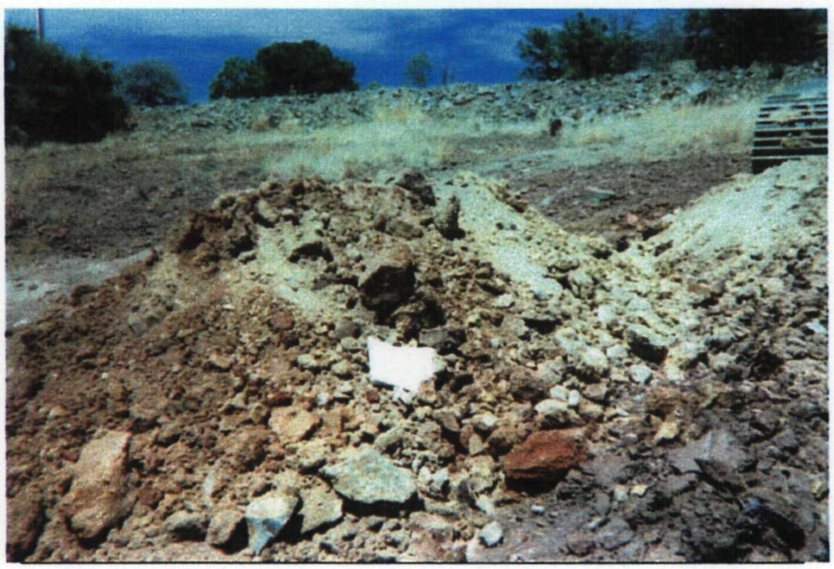


ROOT ZONE DESCRIPTIONS

Cover soil is 4" to 6" thick with vegetation or roots observed.

LITHOLOGIC DESCRIPTIONS

1. (0'-6") Reddish brown cover soil with red chert cobbles (COVER SOIL).
2. (6"- 6') (GC) Clayey Gravel with sand, yellow (5YR 7/4), 30%-50%>1.5" (increasing with depth), primarily red chert and granitic veined with pyrite crystals (<1/4") in clusters and disseminated. Moist, plastic. Clay coatings on clasts. Below 4', feldspar in granite is weathered to clays. Orange, purple, and yellow precipitates and staining in clays. (STOCKPILE MATERIAL)
3. (6'-6.5') Mixed red and brown clayey silt and sand with roots and stockpile material described above. Reddish clay coatings on clasts. (MIXED STOCKPILE MATERIAL AND ORIGINAL SOIL SURFACE)
4. (6.5'-9') (GP) Poorly sorted Gravel with some fines, light brown, loose, 20%>1.5", coarse fraction is weathered pink/green altered granite. Fines are slightly moist with low plasticity. Roots from soil layer above extend to depth of 8'. (COLLUVIUM)
5. Slightly weathered pink/green altered granite. (WEATHERED BEDROCK)



SAMPLES

NO.	DESCRIPTION
u-03-52-11	2'- 4' composite
u-03-52-12	8' top soil
u-03-52-13	9' fractured bedrock

SPECIAL NOTES:

1) No groundwater encountered.
2) Test pit backfilled with excavated mineral.
3) Refusal met at 9'

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FIELD TEST PIT LOG

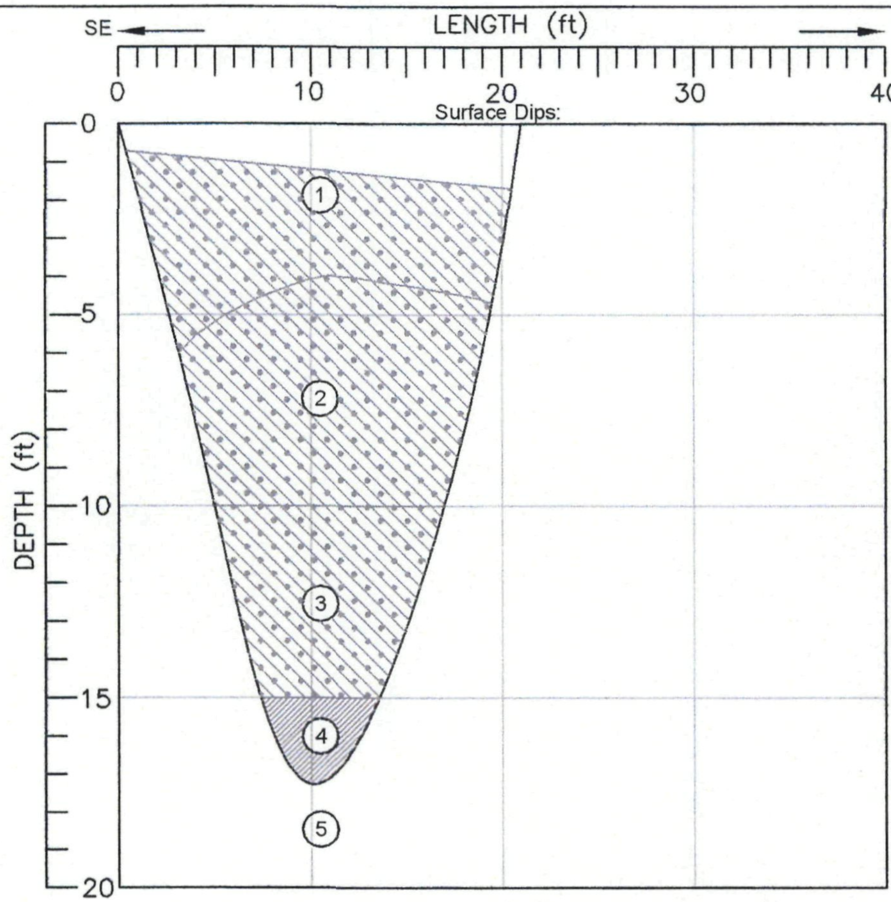
TEST PIT G3-2

TEMP ____°F WEATHER ____ ENGINEER Jen Pepe OPERATOR G. Shepard

EQUIPMENT 235 Cat Excavator CONTRACTOR James Hamilton Construction DATE 6/13/00

ELEVATION 6064.3 DATUM ____ JOB 003-2562

LOCATION Groundhog Mine, New Mexico



ROOT ZONE DESCRIPTIONS
Cover soil 6" to 1' from southeast to northwest. Few roots. Roots extend to base of soil cover.

LITHOLOGIC DESCRIPTIONS

1. (1'-4') (GC) Sandy gravel with fines, orangish brown, 40%>1.5", primarily limestone and dolomite with few granitic and porphyry w/pyrite phenocrysts. Slightly moist, plastic, reacts with HCl.
2. (4'-10') (GC) Clayey gravel with sand, light brown (10YR 6/3), 40%-50%>1.5", primarily carbonates (limestone and dolomite highly mineralized with pyrite and galina), granite, and porphyry w/pyrite and feldspar phenocrysts. Moist, highly plastic. Reaction with HCl strong at 4' decreasing to no reaction below 8'. Cobbles have thick soft weathering rind of iron-stained clay (10YR 5/8). Coarse fraction grades from mostly carbonates at the top of the interval to mostly highly weathered granitics and porphyry at base of interval. (STOCKPILE MATERIAL)
3. (10'-15') (GC) Orange, dark brown, and pink highly weathered granite, moist. Granitic crystalline structure recognizable, but weathered to clays so highly that material is moldable with hands. Secondary gypsum on fracture planes below 12' (WEATHERED GRANITE)
4. (15'-17') (MC) Clayey silt with sand is dark brown, very moist (thin silt stringers are saturated), plastic, minor white and orange precipitates at contact in clays, roots present. (ORIGINAL SURFACE SOIL)
5. Pink/green altered granite (BEDROCK)

SAMPLES

NO.	DESCRIPTION
u-03-52-07	2'- 4' composite
u-03-52-08	6'- 8' composite
u-03-52-09	10'- 12' composite
u-03-52-10	16'

SPECIAL NOTES:

1) *No groundwater encountered.*
2) Test pit backfilled with excavated mineral.
3) Refusal met at 17'3".

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FIELD TEST PIT LOG

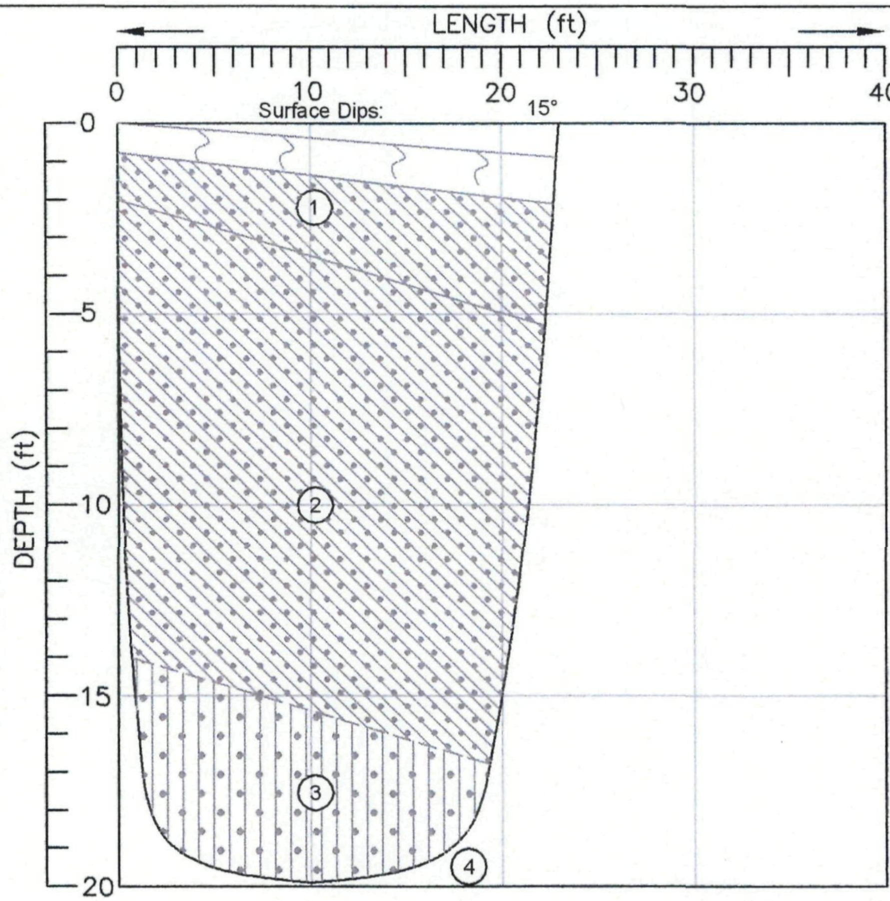
TEST PIT G3-3

TEMP ____ °F WEATHER ____ ENGINEER Jen Pepe OPERATOR G. Shepard

EQUIPMENT 235 Cat Excavator CONTRACTOR James Hamilton Construction DATE 6/13/00

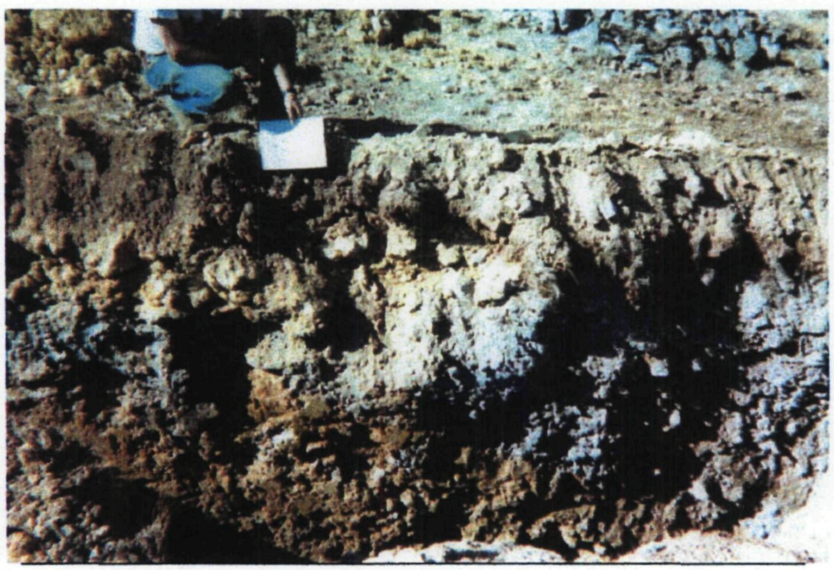
ELEVATION 6057.3 DATUM ____ JOB 003-2562

LOCATION Groundhog Mine, New Mexico



ROOT ZONE DESCRIPTIONS
Soil cover is 6" to 1' thick. Roots extend below soil cover 4" to 5". Root density variably sparse to medium.

LITHOLOGIC DESCRIPTIONS	
1	(1'-3', approx.) (GC) Clayey gravel with sand, light brown to gray, 50%>1.5", including limestone and dolomite with minor veins of galina and pyrite crystals, and pink/green altered granite. Some cemented aggregates (>2'). Slightly moist, plastic, reacts with HCl. (STOCKPILE MATERIAL)
2	(3'-15', approx.) (GC) Clayey gravel with sand, light brown, 40%-50%>1.5", primarily carbonates (limestone and dolomite highly mineralized with pyrite and galina), granite and porphyry w/pyrite and feldspar and minor pyrite phenocrysts. Moist, highly plastic. Reaction with HCl weak at 4' decreasing to no reaction below 6'. Cobbles have thick soft weathering rind of iron-stained clay (10YR 5/8). Coarse fraction grades from mostly carbonates at the top of the interval to mostly highly weathered granitics and porphyry at base of interval. Gypsum crystals present on fracture planes and in void spaces below 12'. (STOCKPILE MATERIAL)
3	(15'-20') (GM) Sandy gravel with fines, gray, 50%>1.5", slightly weathered primarily green altered granite and minor light brown mudstone. Some clay lenses. (WEATHERED BEDROCK)
4	Pink/green altered granite. (BEDROCK)



SAMPLES	
NO.	DESCRIPTION
u-03-52-04	2'
u-03-52-05	4'-12' composite
u-03-52-06	16'- 20' composite

SPECIAL NOTES:

1) No groundwater encountered.
2) Test pit backfilled with excavated mineral.
3) Refusal met at 20'.

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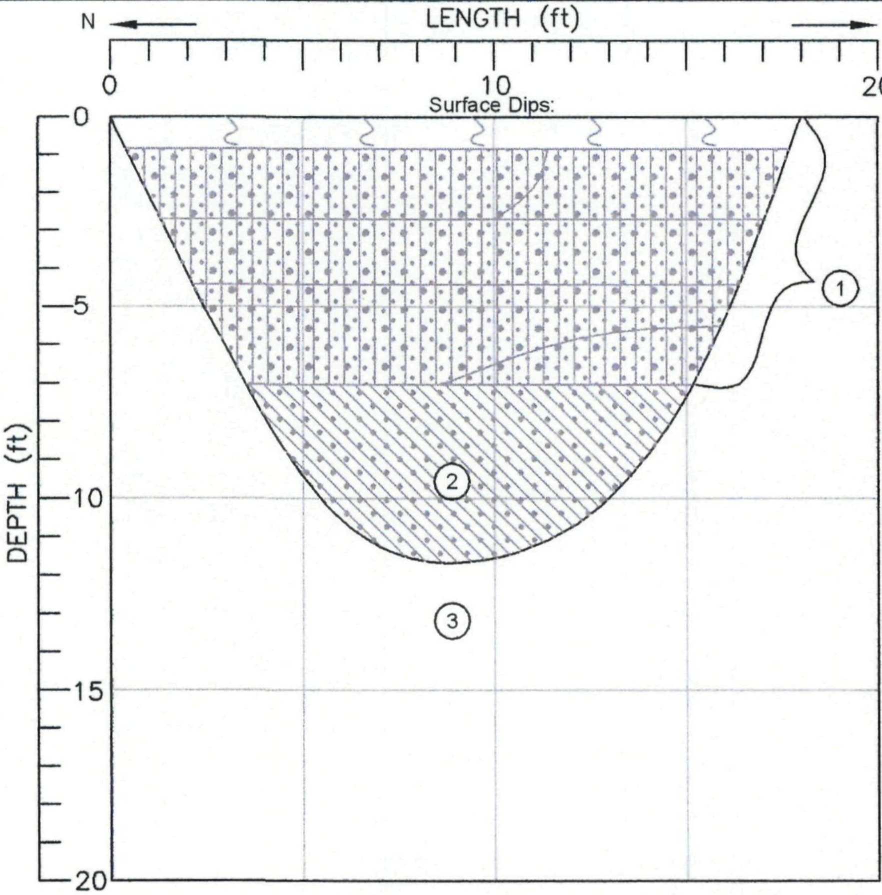
FIELD TEST PIT LOG

TEST PIT G3-4

TEMP 80 °F WEATHER Fair ENGINEER Jen Pepe OPERATOR G. Shepard
EQUIPMENT 235 Cat Excavator CONTRACTOR James Hamilton Construction DATE 6/12/00
ELEVATION 6046.3 DATUM JOB 003-2562
LOCATION Groundhog Mine, New Mexico



ROOT ZONE DESCRIPTIONS

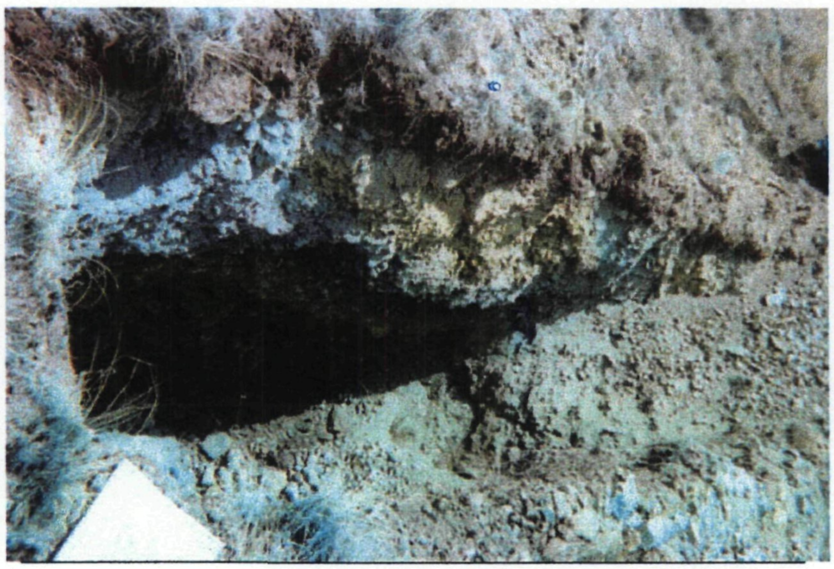
Cover soil is 1' thick. Roots medium dense extending several inches below cover soil.

LITHOLOGIC DESCRIPTIONS

1. (1'-7') (GP-GM) Poorly graded gravel with sand and fines, yellowish orange to gray in approx. 2' lenticular beds, 50%-85%>1.5", including quartz porphyry with feldspar and mica phenocrysts, and limestone and dolomite (some mineralized with pyrite, galena, and Cu hydroxides). Angular cobbles up to 1' diameter. Low to medium plasticity, loose to medium dense, slightly moist to moist (increasing with depth), weak to strong reaction with HCl (becoming weaker with depth). Soft jarosite and limonite weathering rinds on cobbles at base of interval. (STOCKPILE MATERIAL)

2. (7'-11.5') (GC) Clayey gravel with sand, color varies, 60%>1.5", primarily blocky angular dolomite, limestone mudstone, and pink fine-grained granite. Very moist, highly plastic, reacts with HCl. Dark brown clay lenses. (DISTURBED ORIGINAL SURFACE)

3. Pink/green altered granite (BEDROCK)



SAMPLES

NO.	DESCRIPTION
u-03-52-02	2'- 6' composite
u-03-52-03	8'-10' composite

SPECIAL NOTES:

1) No groundwater encountered.
2) Test pit backfilled with excavated mineral.
3) Refusal met at 11'- 7".
4) Pit excavated parallel to slope.

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FIELD TEST PIT LOG

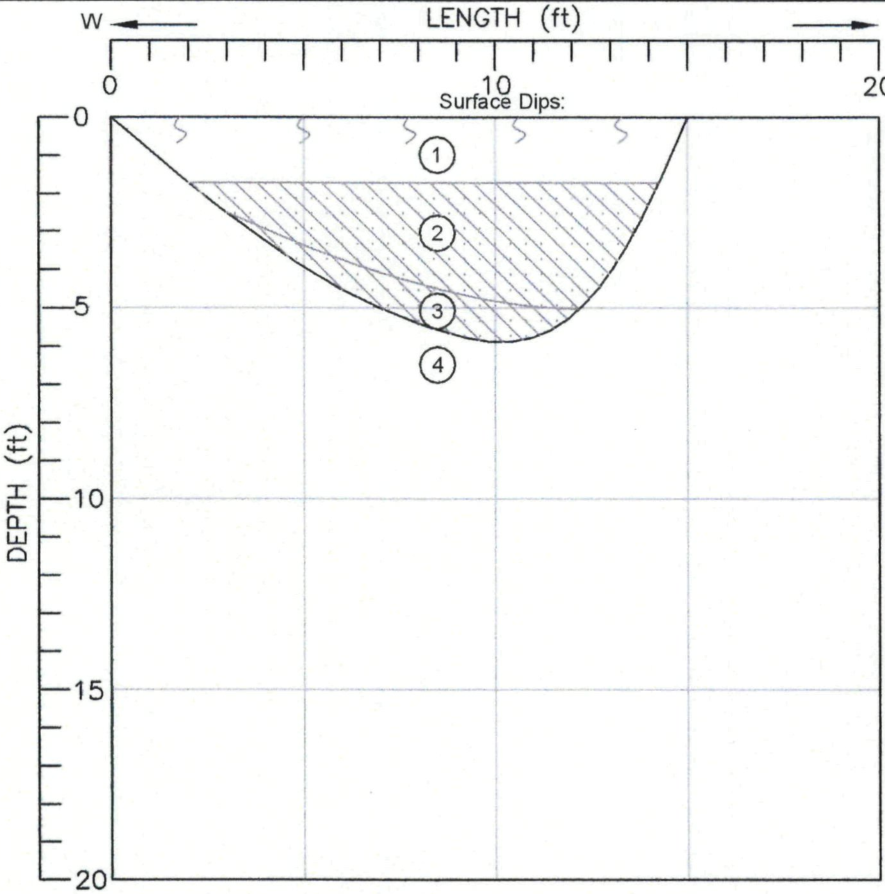
TEST PIT G4-1

TEMP ____ °F WEATHER ____ ENGINEER Jen Pepe OPERATOR Pam Ammons

EQUIPMENT Cat Backhoe 2689 CONTRACTOR James Hamilton Construction DATE 6/20/00

ELEVATION 6007.9 DATUM ____ JOB 003-2562

LOCATION Groundhog Mine, New Mexico



ROOT ZONE DESCRIPTIONS

Cover soil 1.5' thick. Vegetation and roots are dense and healthy. Roots extend below soil cover up to 5".

LITHOLOGIC DESCRIPTIONS

1. (0'-1.5') Dark brown blocky cover soil. (COVER SOIL).
2. (1.5'-6') (SC) Gravelly sand with clay, yellowish (10YR 7/4), 10%>1.5", primarily weathered granite and tuff with some quartz porphyry with disseminated fine pyrite crystals. Slightly moist, moderate plasticity. Lense of angular cobbles (3"-4" diam.) at 5 foot depth, primarily tuff with minor quartz porphyry. (MIXED STOCKPILE MATERIAL AND WEATHERED GRANITE)
3. (6') (SC) Thin layer of sandy clay, dark brown to reddish brown, with occasional cobbles of weathered tuff. Moist. Roots and gypsum crystals present. (ORIGINAL SURFACE)
4. Fractured, weathered tuff. (SUGARLUMP TUFF)

SAMPLES

NO.	DESCRIPTION
u-03-52-30	2'- 4' composite
u-03-52-31	6' top soil

SPECIAL NOTES:

1) No groundwater encountered.
2) Test pit backfilled with excavated mineral.
3) Refusal met at 6'.
4) Pit dug parallel to slope.

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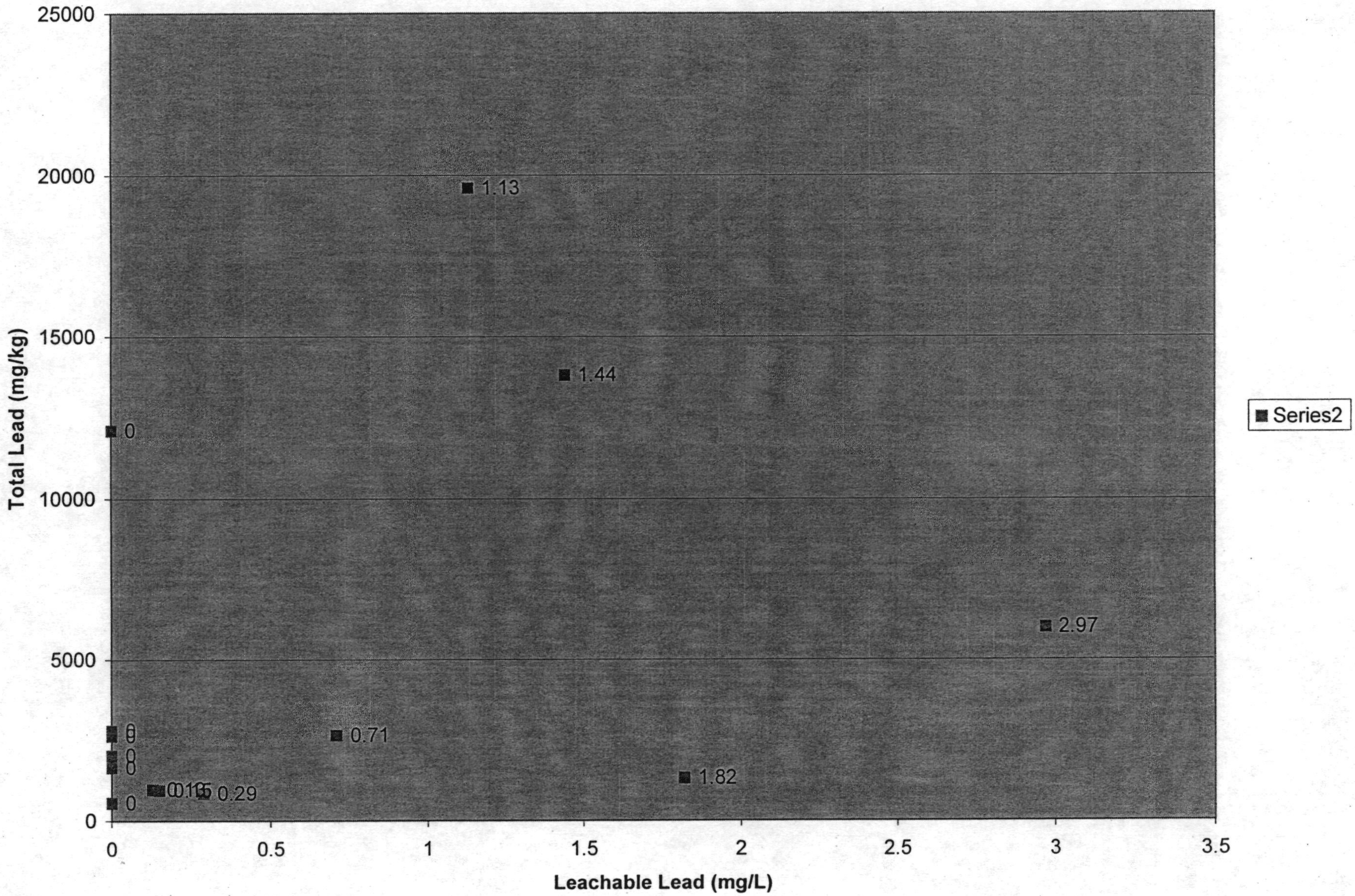
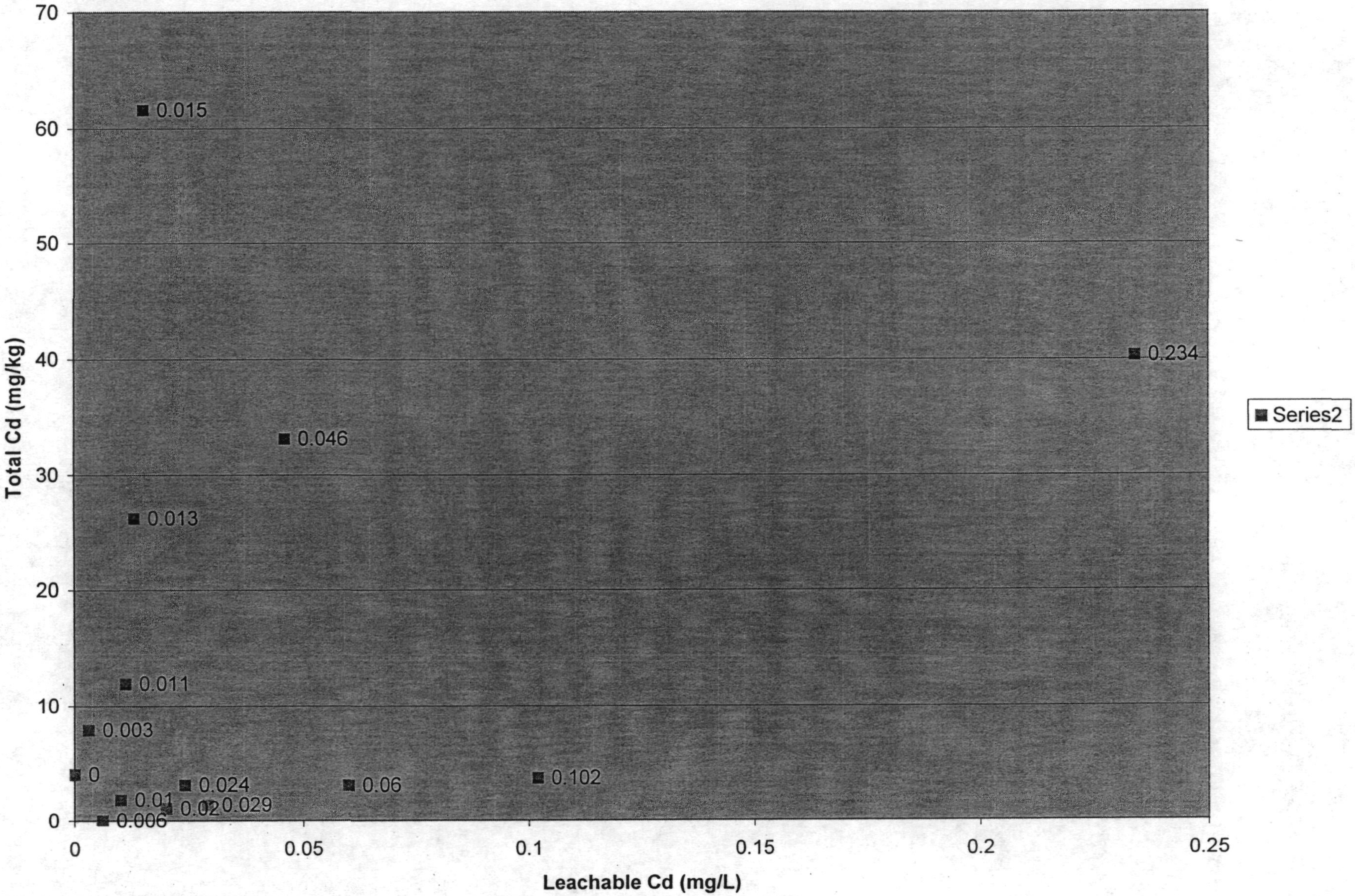
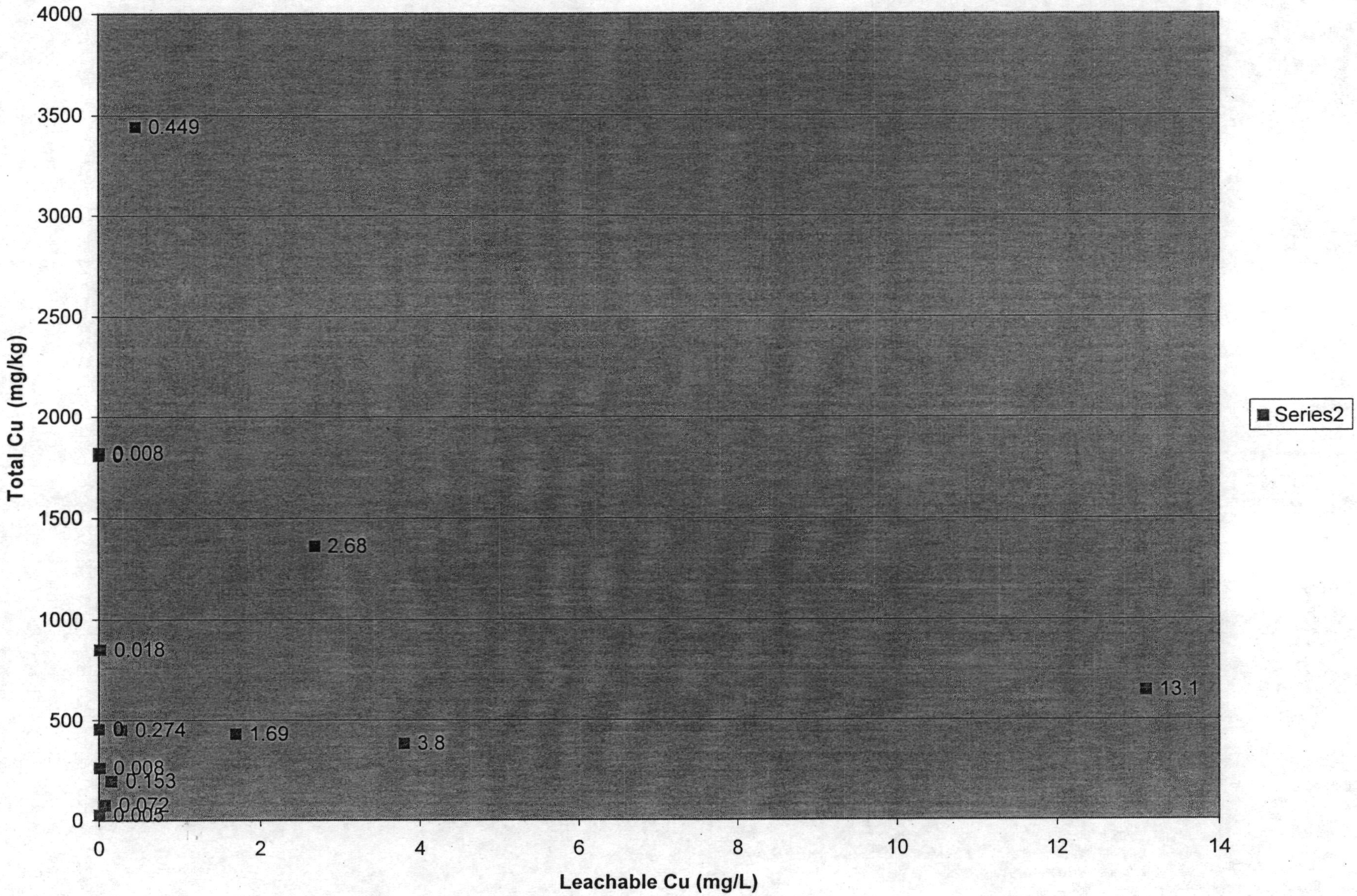
APPENDIX D

SCATTER PLOTS

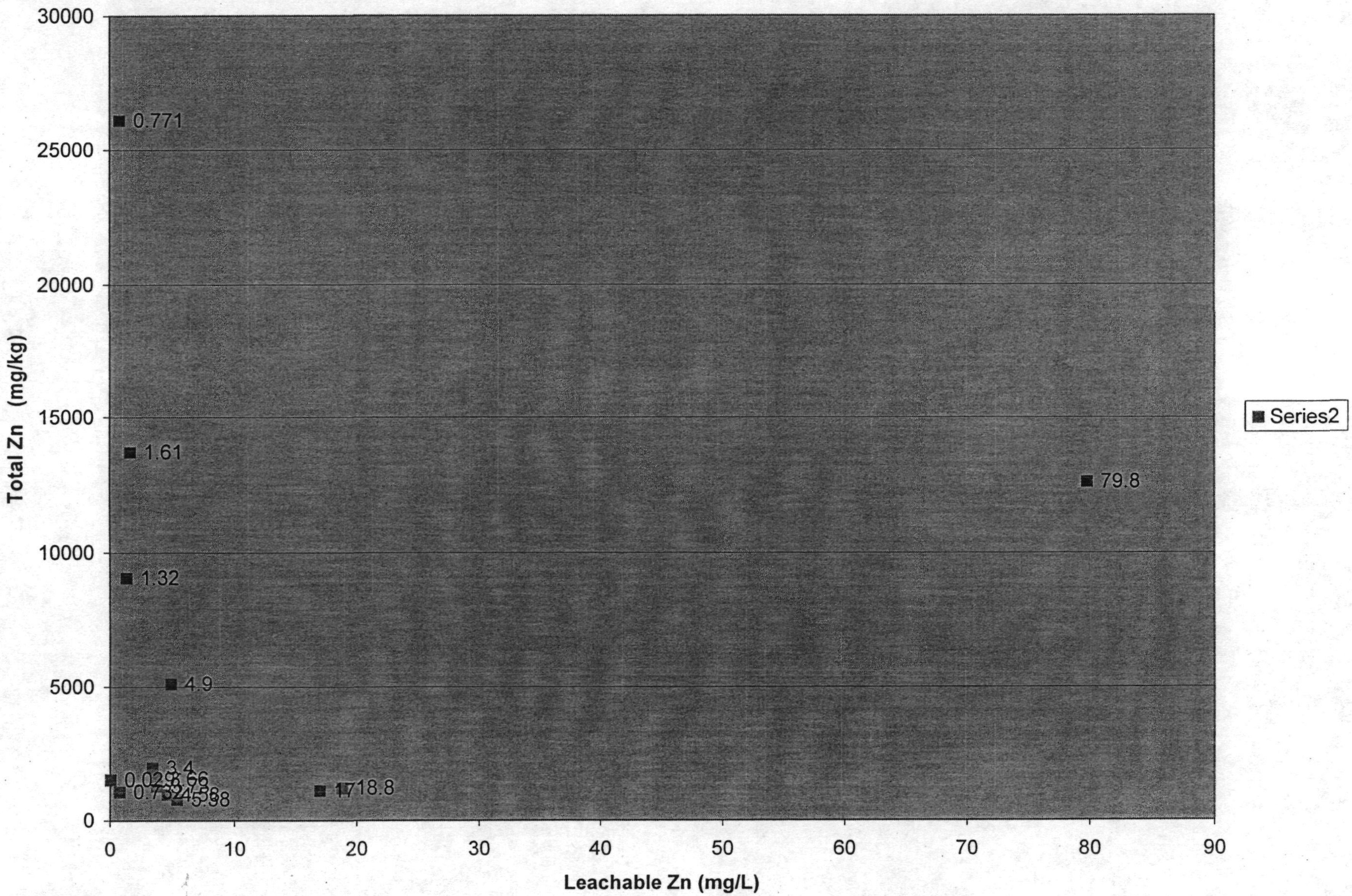

25000
20000
15000
10000
5000
0
Total Lead (mg/kg)
0
0.5
1
1.5
2
2.5
3
3.5
Leachable Lead (mg/L)
1.13
1.44
0
2.97
0.71
1.82
0.29
0
Series2



Total Cd (mg/kg)
Leachable Cd (mg/L)
0
10
20
30
40
50
60
70
0
0.05
0.1
0.15
0.2
0.25
0.015
0.234
0.046
0.013
0.011
0.003
0
0.024
0.06
0.102
0.01
0.02
0.029
0.006
Series2



4000
3500
3000
2500
2000
1500
1000
500
0
0.449
0.008
2.68
0.018
13.1
0.274
1.69
3.8
0.008
0.153
0.072
0.005
0
2
4
6
8
10
12
14
Total Cu (mg/kg)
Leachable Cu (mg/L)
Series2



30000
25000
20000
15000
10000
5000
0
Total Zn (mg/kg)
0
10
20
30
40
50
60
70
80
90
Leachable Zn (mg/L)
0.771
1.61
1.32
4.9
3.4
79.8
18.8
Series2

APPENDIX E

VOLUME CALCULATIONS

Golder Associates

SUBJECT Groundhog Volume Calculations – G1		
Job No. 003-2562	Made by JP	Date 9/21/00
Ref.	Checked	Sheet 1 of 2
	Reviewed	

Volume Calculations for G1:

Samples G1-1 (2') – likely acid producing, moderate AGP, no ANP, 0.92% pyritic Sulfur, some metals

(4') – underlying soil, similar to WR for ABA – 0.46% pyritic S. Similar metals content, Pb higher in Soil.

SPLP G1-1

(2') – Leaches Al, Cd, Co, Cu, Fe, Mn, Pb, Zn, TDS above gw standards.
– leaches Al, Cd, Pb above surface water standards.

(4') – leaches Cd, Cu, Mn, Pb, above gw standards
– leaches Cd, Pb, Zn above surface water Standards

clean

G1-2 (2') – LS Cobble layer – Not acidic, high ANP, low AGP
0.06% pyritic S.

(4') – LS/WR mixed – Not acidic, high ANP, low AGP
0.26% pyritic S

(6') – LS/WR/gypsum – Not acidic, similar to above
0.22 pyritic S

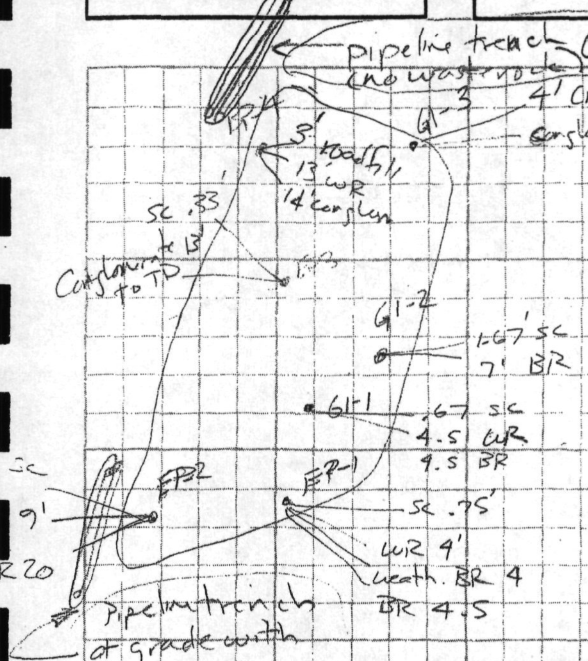
SP-3 (2') – Yellow, sulfur smell, clayey, pyrite xtals.
– Likely to produce, very high AGP, no ANP.
3.63% pyritic Sulfur
high lead

(17') – Conglomerate, under WR
– Low potential to generate acid, low AGP, low ANP, 0.03 pyritic S.
low lead

G1-3 (2') – vegetated soil mixed – stored acidity
low AGP, No ANP, .22% pyritic S. High Pb

(4')(6') – underlying Conglomerate – Not acidic,
0.02%, 0.01% pyritic S.

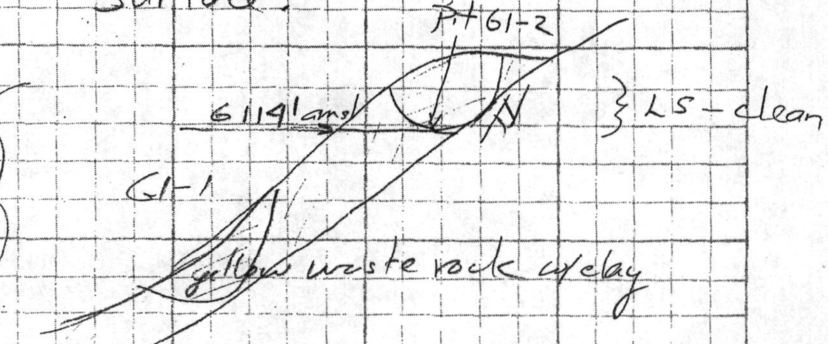
Golder Associates	SUBJECT Groundhog Volume Calculations (G1)		
	Job No. 063-2562	Made by JP	Date
	Ref.	Checked	Sheet 2 of 2
		Reviewed	



base of
SC = soil cover
WR = stock pile material
U = underlying soil
BR = Bedrock.

G1-3 – Underlying conglomerate clean, excavate to top of conglomerate

G1-2 – clean to TD. Top of hill appears to be a cap of LS. Assume this is constant over top, based on field observations of surface.



assume base of G1-2 can be scraped from top of pile and stockpiled during any removal of acid materials beneath.

EP-1 – Remove to top of Bedrock
EP-3 – underlying conglomerate can be left in-place
EP-4 – " " " " "

EP-2 – No analyses on underlying – assume 1½ feet of underlying material will be removed, this would remove shallow leaching effects from original surface and would grade conveniently with surrounding topography.

Lateral delineation matches well with control points from pits, trenches. Error: lateral ±10'
vertical ±5'

$V_{total} = 17,338\ yd^3$

$V_{Top} =$

$A\ total = 54,422$

$A_{Top} =$

Golder Associates

SUBJECT Groundwater Volume Calculations (G2)		
Job No. 003-2562	Made by SP	Date 9/26/00
Ref.	Checked	Sheet 1 of 2
	Reviewed	

Volume calculations for G2:

Samples: (G2-1) (2'-6') WR – Likely to generate acid, low AGP, low ANP, 0.21% pyritic sulfur, high Pb (19,600 mg/kg)

Soil is very thin

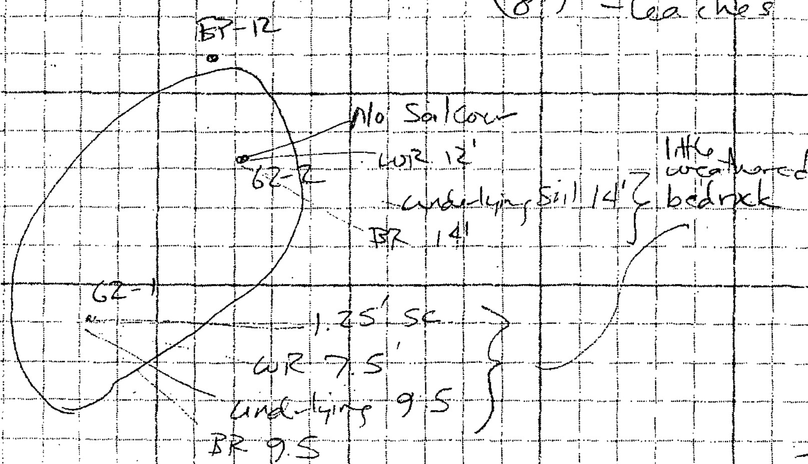
(8') Underlying Soil – Likely to generate acid ★ Same as above but low Pb (2010 mg/kg)

(G2-2) (2'-10') – possibly acid generating, AGP 28.1, ANP 46.7, pyritic S = 0.9%, High Pb (18,600 mg/kg)

★ (14') underlying Soil – Not acid generating, low AGP, fairly low ANP, pyritic S = 0.08%, lower metals than above, low Pb (59 mg/kg)

SPLP G2-1 (2'-6') – leaches Cd, Mn, Pb above gw standards
– leaches Cd, Pb, Zn above Surface water standards

(8') – leaches Mn above Surface water standard



Underlying Soil is fractured bedrock with some AGP, but low pyritic sulfur (<0.3%), and leached only Mn in SPLP tests

Could leave in place or remove. Calc. volume of Total pile and volume of remaining wasterock only.

- Depth to bedrock surface approximated by adjacent topography, test pit elevation data, historical aerials. (Underlying soil/fracture bedrock is 2' thick in both pits and 3' thick in adjacent EP-12. The volume of the Soil was estimated as a 2-foot thick layer at the base of the pile.

$V_{Total} = 12,270\ yd^3$ $\qquad$ $V_{Underlying\ Soil} = (40,210\ ft^2)(2') = 80,420$

$\qquad = 40,210\ ft^2$ $\qquad\qquad = 40,210\ ft^2$

Golder Associates	SUBJECT Groundhog Volume Calculations (G2)		
	Job No.	Made by JonPepx	Date 9/26/00
	Ref.	Checked	Sheet 2 of 2
		Reviewed	

Soil cover is variable over G2, western portion is probably under the road. The sloped portion at the northern end has sparse vegetation.
Assume 1.25 feet of salvageable soil cover over 30% of the footprint area (in the Southeast portion of the pile)

$$V_{soil\,cover} = (1.25\,ft)\left(\frac{40210\,ft^2}{3}\right) = \underline{16,754\,ft^3} =$$

Error = lateral ±20 (due to buried portion to west)
= vertical ±5'

Golder Associates

SUBJECT ~~Groundwater~~ Volum. Calculations G3-east		
Job No. 003-2562	Made by JP	Date 9/26/00
Ref.	Checked	Sheet 1 of 2
	Reviewed	

Volume Calcs for G3 East: (No Carbonates)

Samples: G3-1 (2'-4') - "Likely" generates acid
high AGP, No ANP, 1.71% pyritic S
★ High lead (11,900 mg/kg)
Sulfur smell "

No As — (8') - underlying Soil - "likely" generates acid, low AGP, No ANP, but only 0.06% pyritic Sulfur

High Pb

(9') - underlying fractured bedrock - low potential fairly low ANP, low AGP, 0.13% pyritic sulfur

No SPLP, except F1, but similar materials at G1 leach Pb above standards at much lower total lead contents.

EP5 (3') - Sample of mixed fill / yellow WR at toe of G3-east

As, low Pb — "likely" to generate acid, high AGP, no ANP
1.19% pyritic sulfur
— Some metals

EP-6 (3') - Sample of granitic waste rock, grassy area
- "likely" to produce acid, low AGP, no ANP, 0.12% pyr. S.

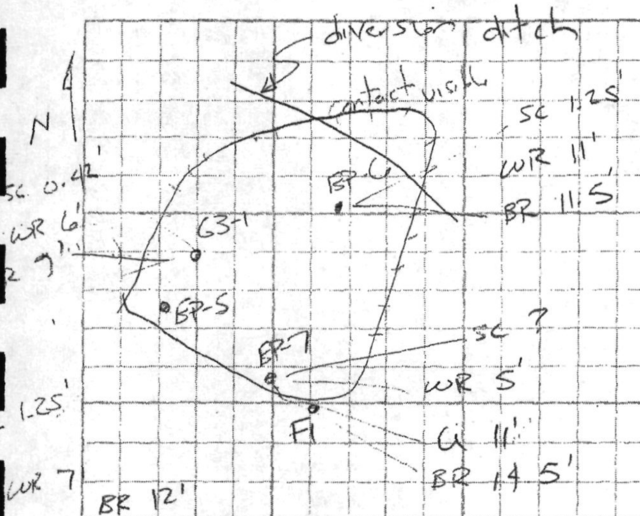
As, Pb (3520 mg/kg) — Some metals

F1 — From loading ramp (?) at toe of G3 east, same red cherty SS as seen on the hillside of G3 east.
- Likely to produce acid, Some AGP, low ANP
0.73% pyritic S,

As, High Pb

SPLP - leaches Cd, Mn, Pb above gw standards.
- leaches Cu, Zn above Surf water standards.

Golder Associates	SUBJECT Volume Calculations Groundhog G3-east		
	Job No. 003-2562	Made by JP	Date 9/26/00
	Ref.	Checked	Sheet 2 of 2
		Reviewed	



Base of:
SC = Soil cover
WR = stockpile
U = underlying Soil
BR = Bedrock contact (refusal)

Generally, the hillside has variable AGP, but no ANP, and contains Pb + other leachable metals. The NE Portion is less acidic + grows vegetation, but is highly weathered + contains "pockets" of acid yellow materials w/sulfur smell.

Underlying Soils are impacted to a lesser degree, but Bedrock appears less impacted. Soils are fairly thin (0' to NE grading to a max of 5' to the SW.) If Stockpile is removed, Soils should also be removed, or contained.
Calculate V of all above Refusal.
Remove Soil Cover along with other material, it is sterile in some areas and would be difficult to remove and stockpile.

Total V based on field observations of surface contacts and estimates of lateral + vertical extent using aerial photos, in addition to pits.

$$V_{total} = 512,892\ ft^3 = 18,996\ yd^3$$

$$A_{total} = 59,109\ ft^2 = 1.36\ acres$$

errors — $\pm$ 10' lateral
$\pm$ 5' vertical

Golder Associates

SUBJECT Groundwater calcs. (G3 West)		
Job No. 003-2562	Made by Jen Pepe	Date 9/26/00
Ref.	Checked	Sheet 1 of 2
	Reviewed	

Volume Calculation for G3 West:

Samples G3-2 (2'-4')(6'-8')(10'-12') → Likely acid generating (decreasing ANP and AGP w/ depth)
wasterock weathered pyritic fill
> 1% pyritic sulfur

(16') underlying Soil → possibly acid generating but only 0.01% pyritic S
Low AGP, No ANP

SPLP
G3-2 (2'-4') shallow sample highest in metals, leaches Cd, Mn, TDS, SO_4 above gw standards
Leaches Cd above surface water standards

G3-3 (2') — possibly acid generating, high metals, high AGP, high ANP (3% pyritic sulfur)
wasterock
(4'-12') — likely generates acid high AGP, low ANP, (1.5% pyritic sulfur). less metals, still high
wasterock
(16'-20') — possibly generates acid ANP ≈ AGP (26, 22.8
underlying — (.73% pyr. sulfur) lower metals, low Pb.

SPLP
(4'-12') — leaches Al, Cd, Cu, Mn, Pb, Zn, TDS, Fe, SO_4 above gw standards
— No surface water exceedances

G3-4 (2'-6') — Possibly acid generating, AGP, ANP both high, 1.86% pyritic S, metals similar to G3-3
wasterock
(8'-10') — Low potential to generate acid, high ANP, low AGP, 0.48% pyritic S.
underlying
Similar metals to underlying soil @ G3-3

EP-10 (suspect materials) (8') — possibly acid generating, high ANP, high AGP, 2.21% pyritic S.
high metals, high Pb.
SPLP - Leaches Cd, Mn, TDS, SO_4 above gw standards
—No sw exceedances

Golder Associates

SUBJECT Groundhog ∀ calcs G3 West		
Job No. 003-2562	Made by JP	Date 9/26/00
Ref.	Checked	Sheet 2 of 2
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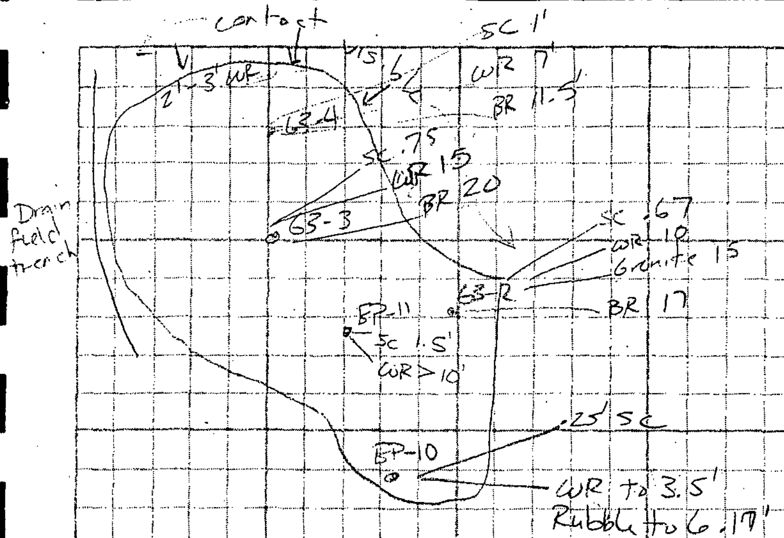


Base of:
SC = Soil cover
WR = stockpile Material
U = underlying surface materials
BR = Refusal
WBR = weathered BR

EP1-10 – Remove all (WR + Rubble)
G3-2 – Remove all (only 2' at bottom is "possible", not worth leaving it there.)
G3-3 – Remove all (underlying material is mineralized, "possibly" AG)
(X) G3-4 – could leave underlying material?

Estimate 1' thick SC over footprint surface area = (1')(167,157 ft²) = 167,157 ft³

– Assume all material would be removed if removal action chosen. (original surface soils at northern portion of pile may be OK to leave in-place, but would require additional sampling to determine).

Total ∀ estimated by CAD from delineation of lateral extent (visual observations + aerial photos).

$$\forall_{Total} = 72,466\ yd^3 = 1,956,582\ ft^3$$

$$A_{Total} = 167,157\ ft^2 = 3.84\ acres$$

note – granite BR exposed in rill on north edge + on hillside to northeast. Assume soils/weathered bedrock is zero at these locations.

– Trench for drainfield showed 2'-3' of soil overlaying bedrock at western edge → assume 3' at base of pile, plus 1' cover soil = 4' deeper than topo lines

Errors – ± 20 feet laterals
± 10 feet elevations

Golder Associates

SUBJECT Grandhorst calculations (G4)		
Job No. 003-2562	Made by Jen Pepe	Date 7/25/00
Ref.	Checked	Sheet of
	Reviewed	

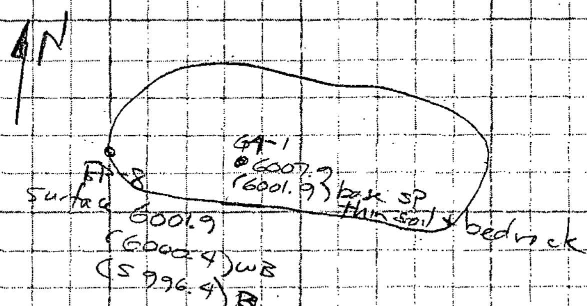
Volume Calculation for G4:

One sample of yellowish granitic stockpile material:

2'-4' composite → NPR = <0.04 (13.2 AGP, no NP)
likely acid generating

→ leaches Mn > gw standards
Zn > Surface water "

underlying soil @ 6' NPR = <1.7, (No NP, 0.3 AGP)
possibly acid generating, but 0.01% pyritic sulfur, not much acid to produce



∀ - To scrape off all stockpile material down to tuff bedrock or old surface.
– No significant soils or weathered bedrock interval beneath waste rock, except 2.5' of material at west edge.

– Delineated lateral extent from aerials, field observations
– Sketched top of original surface → to CAD for ∀ calcs.

$\forall_{sp} = 44{,}010\ ft^3 = 1630\ yd^3$
$A_{sp} = 15{,}233\ ft^2 = .35\ acres$

Soil cover = 1' thick over pile (could be stockpiled + used on an excavated surface at G4)

$\forall_{cs} = 15{,}233\ ft^3$

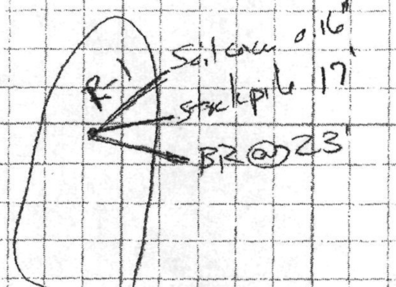
Errors – ±10 feet lateral
± 5 feet elevations

Golder Associates	SUBJECT Groundhog Volume Calculations (GS)
Job No. 003-2562 / Ref.	Made by JB / Checked / Reviewed
Date 9/26/00	Sheet 1 of 1

Calculations for Volume of GS:

Samples: R1 (2'-16') - "low potential" to generate acid.
very high ANP, AGP, 2.41% pyritic S

Similar to G3 west Stockpile



SPLP - Leaches Cd, Mn, TDS, SO_4 above GW standards,
Leaches Cd above Surface Water Standards.

(18') - underlying Soil / channel deposits.
"likely" to produce acid
low AGP, No ANP, 0.29% pyritic S
Some metals

V - To remove lower interval, all would be removed. Total Volume to bedrock calculated. Due to high metals and AGP, it is not likely that the upper interval would be stockpiled while the lower is removed from site.

- Delineated based on aerial photos, field observations. Lateral extent estimated, no contact seen in field.

$V_{btm} = 268,299 \text{ ft}^3 = 9937 \text{ yd}^3$

$A_{Total} = 16224 = .37 \text{ acres}$

Test pit dug in road w/2" thin fill. Thickness of soil cover unknown, assume ≈1' over 80% of surface. (20% covered by road)

$V_{Soil\ cover} = (16,224)(1)(.8) = 12,979 \text{ ft}^3 = 481 \text{ yds}^3$

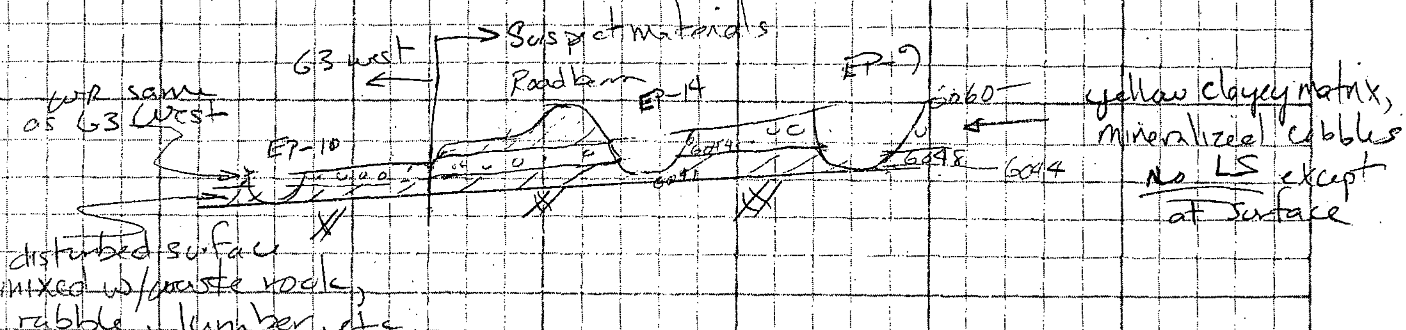
Golder Associates

SUBJECT Groundwater Volume Calculations - Suspect Materials

Job No. 003-2562 | Made by JP | Date 9/27/00
Ref. | Checked | Sheet 1 of
| Reviewed |

Volume Calculations for "Suspect Materials"

No samples, but this area contains yellow clayey mineralized materials as seen at 63 east and 61. LS cobbles were spread on the surface (below soil cover) in EP-9 and grass grows well, esp in the uphill (east) portion. Material above WR = LS cobbles + Soil cover = 3" to 20" (avg 1') at EP9. cover = 1' at EP-14. Assume 1' salvagable. Assume materials are likely "acid generating based on analyses of similar materials. Lower interval is mixed with solid wastes such as concrete, metal scraps, fabric, lumber, etc.



Removal of acidic waste rock would require subsequent removal of underlying soils mixed with waste rock and debris. Volume calculated as total

$V_{Total} = 1,470,717 \text{ ft}^3 = 54,471 \text{ yd}^3$

$A_{Total} = 102,994 \text{ ft}^2 = 2.36$ acres

Lateral boundary delineated using aerial photos, field observations of contacts at surface, and test pits

Error: Lateral ±10' except under road to the west, south of EP-10. There may be ±30 feet, could not get closer than that to the pipeline while digging.
vertical ±5'

$V_{soil\ cover} = 102,994 \text{ ft}^3$